NexGen Energy Ltd.

Rook I Project

Environmental Impact Statement

Annex VI: Terrain and Soils Baseline Report

GOLDER MEMBER OF WSP

TERRAIN AND SOILS BASELINE REPORT FOR THE ROOK I PROJECT

Prepared for:

NexGen Energy Ltd.

Prepared by:

Golder Associates Ltd.

March 2022

Executive Summary

This terrain and soils baseline report is a component of a comprehensive baseline program that documents the natural and socio-economic environments in the anticipated area of the Rook I Project (Project). The terrain and soils baseline program was undertaken to provide context from which effects on terrain and soils from the Project could be assessed in the Rook I Environmental Impact Statement (EIS).

A maximum disturbance area was used to account for potential changes to the Project footprint during continuing design activities so that adverse effects are not underestimated. The maximum disturbance area for terrain and soils is approximately 913 ha, and the spatial boundary was delineated to include the Project footprint plus a 100 m buffer around the outermost facilities, as well as the associated access road plus by a 100 m buffer. A local study area (LSA) was established to capture the combined potential direct and indirect effects of the Project on terrain and soils resources. The LSA is approximately 4,560 ha and is defined by a 1 km buffer around the maximum disturbance area.

Terrain and soils field programs, including terrain and soil classification and soil chemistry analysis, were completed in 2018 and 2019. Information from the terrain and soils field programs was used to determine soil mapping and map unit designation for the maximum disturbance area, and soil suitability for reclamation and soil sensitivities for the LSA.

The objectives of the terrain and soils baseline study, to obtain information on terrain and sensitive terrain, characterize existing soil quality and distribution and determine baseline soil chemistry and evaluate soil sensitivities within the maximum disturbance area and LSA, have been met. The data and subsequent evaluation of the terrain and soils present in the maximum disturbance area meet the requirements for submission under the *Environmental Assessment Act* (Saskatchewan) and the *Canadian Environmental Assessment Act, 2012* (CEAA 2012) following the Generic Guidelines for the Preparation of an Environmental Impact Statement Pursuant to CEAA 2012.

Soil sensitivities within the maximum disturbance area and LSA were determined, and included sensitivity to erosion, acidification, compaction, and potential for permafrost. Uppermost soil texture as well as percent slope and slope length landscape attributes were used to assess water erosion potential with ratings adapted from Transportation Association of Canada guidelines (TAC 2005). Water erosion potential for most soils was Low, based on the dominantly sandy and loamy sand texture. Wind erosion ratings for dominant mineral soil subgroups were defined utilizing textural classes for the uppermost mineral horizon and a dimensionless index described by Coote and Pettapiece (1989). Generally, the wind erosion risk is High based on sandy textured mineral upper soil horizons. Soils with Low wind erosion ratings were associated with organic horizons. Wind erosion potential for organics was interpreted using guidance from Campbell et al. (2002).

Assessments of the soil sensitivity to acidification were evaluated using the chemical criteria from Holowaychuk and Fessenden (1987). Within the maximum disturbance area and LSA, the upland landscape positions containing well-drained and sandy textured soils were found to be most sensitive to acidification. Wetlands and Organic soils (within bogs, fens, and swamps) throughout the LSA were found to have a lower sensitivity to acidification. Permafrost potential was evaluated for each soil subgroup based on drainage, soil texture, and topography.

Brunisolic soils are the dominant subgroups in the maximum disturbance area and LSA and were found to have a Low permafrost potential rating. Organic soils were found to have a Low to Moderate potential to contain permafrost. Soil compaction potential was evaluated based on soil texture and soil moisture regime as outlined in the land management handbook *Developing Timber Harvesting Prescriptions to Minimize Site Degradation* (Lewis et al. 1989). Brunisolic and Gleysolic soils in the Project were determined to have Low sensitivity to compaction under moist soil conditions.

The results indicate the terrain in most of the maximum disturbance area and LSA is composed of undulating to hummocky upland landscape with high relief that is very stony at surface. Soil inspections during the field programs indicate that the maximum disturbance area and LSA predominantly consist of loamy sand textured soils formed from glaciofluvial parent material and outwash depositional settings. Soils were predominantly classified as coarse-grained Brunisolic soils. In topographically lower areas, Gleysolic and Organic soil orders were found. Reclamation suitability was assessed using the soil quality criteria from Alberta Agriculture (1987), and the suitability of the upper lift mineral soils is rated as Poor (Section 4.2.4, Soil Suitability for Reclamation) due to the general soil profile texture within the maximum disturbance area and LSA. Soil chemistry results from the field programs indicated that concentrations of metals within the soil do not exceed the Soil Quality Guidelines for the Protection of Environmental and Human Heath, and radionuclide analysis identified no values exceeding the Canadian Guidelines for the Management of Naturally Occurring Radioactive Materials.

If referencing this report, please use for the following citation:

Golder (Golder Associates Ltd.). 2022. Terrain and Soils Baseline Report for the Rook I Project. Prepared for NexGen Energy Ltd.

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Abbreviation and Units of Measure

Abbreviations	Definition
ALS	Australian Laboratory Services
CanSIS	Canadian Soil Information System
CCME	Canadian Council of Ministers of the Environment
CEAA 2012	*Canadian Environmental Assessment Act, 2012*
CEC	cation exchange capacity
EC	electrical conductivity
EXP	exposure area
GPS	Global Positioning System
LSA	local study area
NexGen	NexGen Energy Ltd.
pH	potential of hydrogen
Project	Rook I Project
REF	reference area
SAR	sodium adsorption ratio
SIL1	Survey Intensity Level 1
SIL2	Survey Intensity Level 2
SMU	soil map unit
SRC	Saskatchewan Research Council
TLU	Traditional Land Use

Units and Symbols	Definition
%	percent
°C	degrees Celsius
<	less than
>	greater than
Bq/g	becquerels per gram
cm	centimetre
dS/m	decisiemens per metre
ha	hectare
km	kilometre
m	metre
mEq	milliequivalents
mg/L	milligrams per litre

1.0 INTRODUCTION

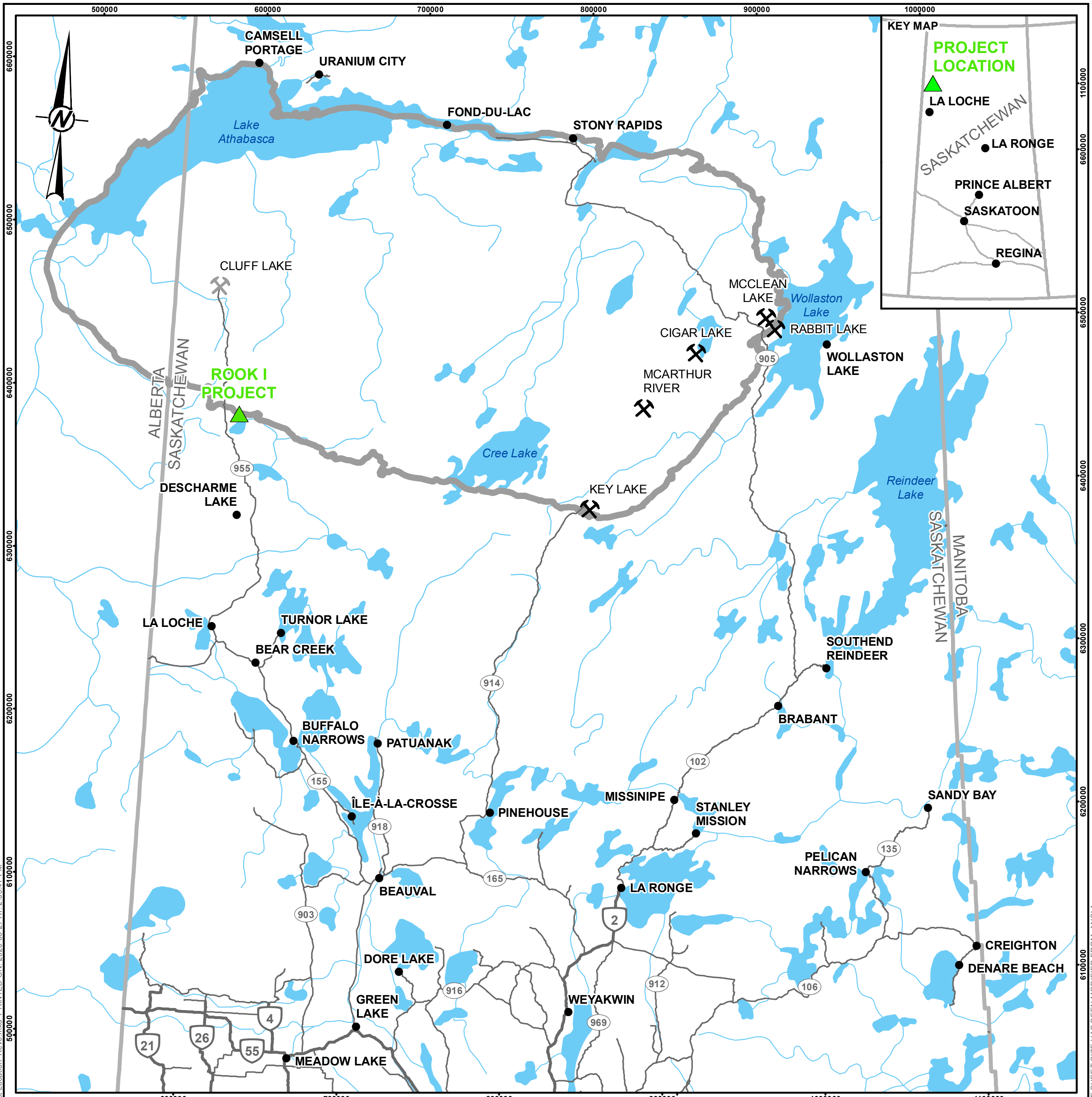
The Rook I Project (Project) is a proposed new uranium mining and milling operation that is 100% owned by NexGen Energy Ltd. (NexGen). The Project would be located in northwestern Saskatchewan, approximately 40 km east of the Saskatchewan-Alberta border, 130 km north of the town of La Loche, and 640 km northwest of the city of Saskatoon (Figure 1). The Project would reside within Treaty 8 territory and within the Métis Homeland. At a regional scale, the Project would be situated within the southern Athabasca Basin adjacent to Patterson Lake, and along the upper Clearwater River system (Figure 2). Access to the Project would be from an existing road off Highway 955. The Project would include underground and surface facilities to support the extraction and processing of uranium ore from the Arrow deposit, a land-based, basement-hosted, high-grade uranium deposit.

The terrain and soils baseline report represents a component of a comprehensive baseline program that documents the natural and socio-economic environments in the anticipated area of the Project. The terrain and soils baseline program was undertaken to provide context from which Project environmental terrain and soil effects could be assessed in the Environmental Impact Statement (EIS).

Since exploration at the Project commenced in 2013, NexGen has engaged regularly and established relationships with local First Nation and Métis Groups (collectively referred to as Indigenous Groups) and northern communities, specifically those closest and with greatest access to the proposed Project. NexGen respects the rights of Indigenous Peoples and the unique relationship Indigenous Peoples have with the environment, and recognizes the importance of full and open discussion with interested or potentially affected Indigenous communities regarding the development, operation, and decommissioning of the proposed Project. Engagement activities to date, as well as future planned engagement activities, reflect the value NexGen places on meaningful engagement with Indigenous and northern communities who could be potentially affected by the proposed Project. Engagement mechanisms have included, but are not limited to: meetings with leadership, workshops and community information sessions, Project site tours, establishing Joint Working Groups to support the gathering and incorporation of Indigenous and Local Knowledge throughout the Environmental Assessment (EA) process, and providing funding for Traditional Land Use (TLU) Studies[1] to understand how the proposed Project may interact with the Indigenous communities' traditional use of the anticipated area of the Project.

Feedback received during engagement activities was documented for contribution to the EIS for the Project; examples of feedback received include discussion of concerns, interests, potential adverse effects, mitigation, and design alternatives. Many baseline studies were initiated in advance of formal engagement on the EA for the Project; however, engagement during the execution of baseline studies has helped inform the understanding of baseline conditions and confirmed components of the natural and socio-economic environments that required study. A summary of feedback related to the terrain and soils baseline program is presented in Appendix A Joint Working Group Feedback Applicable to Terrain and Soils Baseline.

[1] Traditional Land Use (TLU) Studies include all land use studies developed by the Project's affected Indigenous Groups, including Traditional Land Use and Occupancy studies, Traditional Knowledge and Use studies, and Indigenous Rights and Knowledge studies, henceforth referred collectively as TLU Studies.



LEGEND

- POPULATED PLACE
- URANIUM MINING FACILITY (ACTIVE)
- URANIUM MINING FACILITY (DECOMMISSIONED)
- PRIMARY HIGHWAY
- SECONDARY HIGHWAY
- WATERCOURSE
- WATERBODY
- ATHABASCA BASIN BOUNDARY
- PROJECT LOCATION

0 100 200

1:3,500,000 KILOMETRES

REFERENCE(S)

1. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
PROJECTION: UTM ZONE 12 DATUM: NAD 83

CLIENT

NexGen Energy Ltd.

PROJECT

ROOK I PROJECT

TITLE

LOCATION OF THE ROOK I PROJECT, SASKATCHEWAN

CONSULTANT

GOLDER

YYYY-MM-DD	2020-03-27
DESIGNED	SS
PREPARED	NO/AK
REVIEWED	JMC
APPROVED	MM

PROJECT NO.	PHASE	REV.	FIGURE
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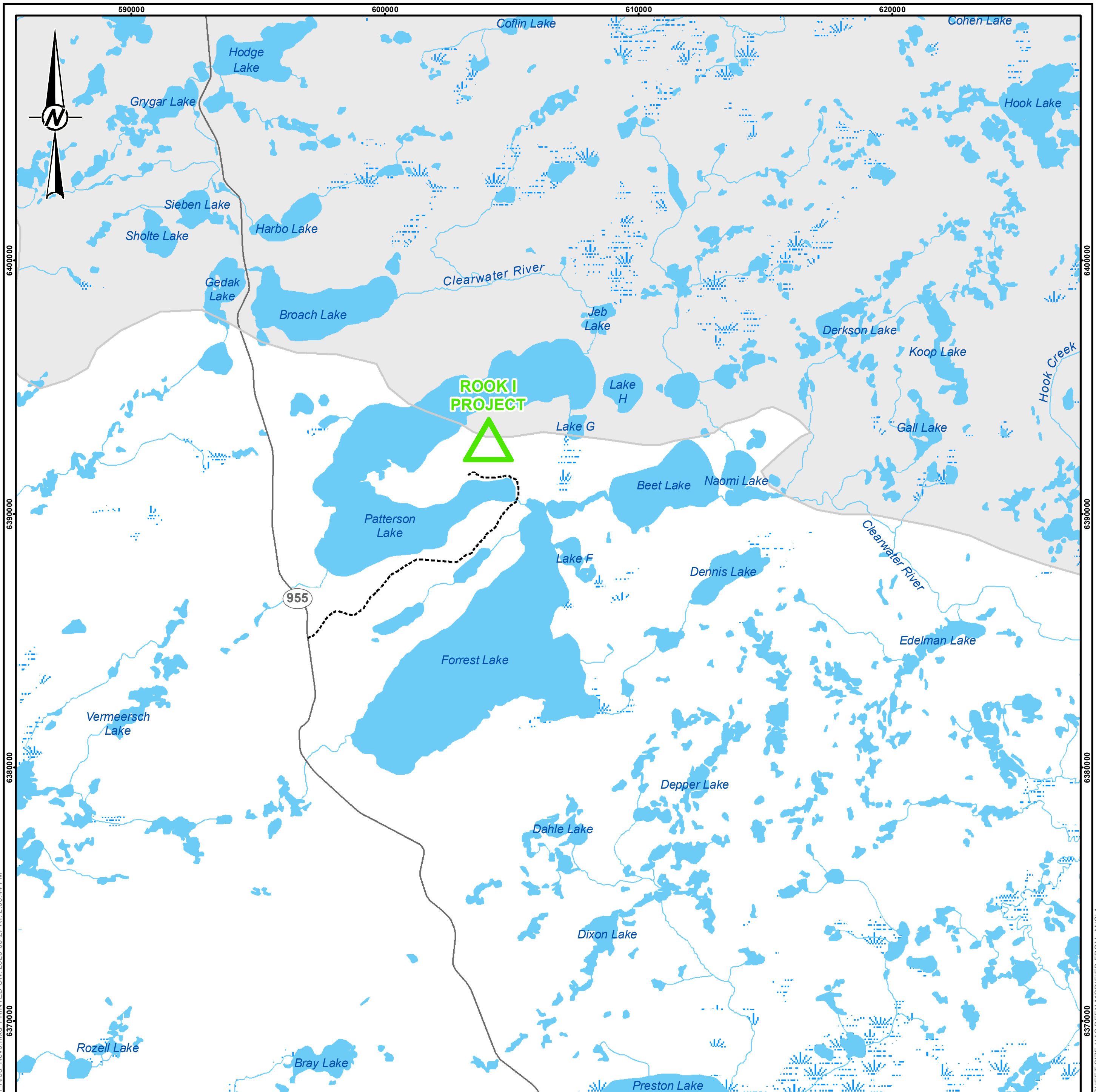

LEGEND

- SECONDARY HIGHWAY
- WATERCOURSE
- WATERBODY
- WETLAND
- ATHABASCA BASIN
- PROJECT LOCATION
- EXISTING ACCESS ROAD

0 5,000 10,000

1:225,000 METRES

REFERENCE(S)

1. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
PROJECTION: UTM ZONE 12 DATUM: NAD 83

CLIENT

NexGen Energy Ltd.

PROJECT

ROOK I PROJECT

TITLE

REGIONAL AREA OF THE ROOK I PROJECT

CONSULTANT

GOLDER

YYYY-MM-DD	2020-03-27
DESIGNED	JMC
PREPARED	NO/AK
REVIEWED	JMC
APPROVED	MM

PROJECT NO.	PHASE	REV.	FIGURE
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2.0 STUDY OBJECTIVES

A terrain and soils baseline study was completed to describe the existing terrain and soils conditions prior to potential development of the Project. This study describes the existing terrain distribution, and soil distribution and conditions. Terrain and soil distribution refers to the amount or abundance and spatial configuration of terrain and soil. Soil conditions (i.e., quality) are defined as the potential for compaction, rutting, erosion, and admixing, as well as sensitivity to acidification and dust deposition. Soil conditions affect the capability of soil to support plants and functionally effective vegetation ecosystems and associated wildlife habitats.

The objectives of the 2018 and 2019 terrain and soils baseline program were to:

- obtain information on terrain and sensitive terrain within the maximum disturbance area and local study area (LSA);
- characterize existing soil quality and distribution within the maximum disturbance area and LSA; and
- determine baseline soil chemistry and evaluate soil sensitivities within the maximum disturbance area and LSA.

3.0 STUDY AREAS

The proposed Project is located within the Firebag Hills Landscape Area, which is within the Mid-Boreal Upland Ecoregion of the Boreal Plain Ecozone of Saskatchewan (Acton et al. 1998). The Firebag Hills Landscape Area consists of mainly gently to strongly rolling morainic plains extending as far south as the Clearwater River Valley, east to the Alberta-Saskatchewan border, north past Patterson Lake, and east to the Boreal Shield Ecozone (Acton et al. 1998).

A maximum disturbance area was used to account for potential changes from the Project during continuing design activities so that adverse effects are not underestimated (i.e., the maximum disturbance area is larger than the Project footprint). The maximum disturbance area represents the smallest scale of assessment and an area where the potential direct effects of the proposed Project on terrestrial components can be assessed accurately and precisely. For the Project, the maximum disturbance area contains existing disturbance from Rook I exploration activities, the proposed Project footprint (e.g., mill, waste rock management area, effluent treatment facility, camp, airstrip, and upgraded access road), a 100 m buffer around the outermost Project facilities (e.g., airstrip, sewage treatment facilities, explosives magazine storage and access road). The maximum disturbance area is approximately 913 ha.

The LSA was established to capture the combined potential direct and indirect effects of the Project on terrain and soils resources and provides context for assessing effects. The LSA is approximately 4,560 ha and is defined by a 1 km buffer around the maximum disturbance area. The outer boundary of the LSA represents the furthest extent to which Project effects on soils and terrain are likely to occur (e.g., effects from dust deposition [Walker and Everett 1987; Meininger and Spatt 1988]). The maximum disturbance area is entirely within the LSA; the evaluation of soils and terrain will be discussed in terms of the LSA throughout this baseline report.

A terrain and soils regional study area was not established for the Project as no measurable ecological effects on terrain and soils are predicted from direct physical disturbance and dust deposition beyond the LSA (Walker and Everett 1987; Meininger and Spatt 1988).

4.0 METHODS

4.1 Review of Existing Information

A preliminary review of existing literature and mapping for soils and terrain in the study areas, and digital and satellite imagery, was completed. The terrain and soils baseline data review was focused on the maximum disturbance area and LSA (Figure 3). An understanding of existing soil and terrain information is a critical component for preliminary mapping and field program planning. Resources include, but are not limited to:

- *The Ecoregions of Saskatchewan* (Acton et al. 1998);
- Saskatchewan Soil Information System (SLRU 2004); and
- Saskatchewan Map Units, Detail 1:100,000 Soil Survey Information (SLRU 2004).

4.2 Approach

In designing the field study, locations of soil inspection sites were varied based on terrain complexity and were selected such that each dominant soil group was inspected. The density of soil inspections within the maximum disturbance area was completed at a Survey Intensity Level 2 (SIL2) (Agriculture Canada 1981). A SIL2 requires a minimum of one soil inspection site per 30 ha and at least one inspection in over 90% of delineated map polygons. This SIL2 density and polygon visitation represents a detailed soil survey (Agriculture Canada 1982), which allowed for the identification of site-specific soil characteristics (i.e., specific areas that require special soil handling) and increased the accuracy and precision of soil mapping (1:5,000) for the maximum disturbance area.

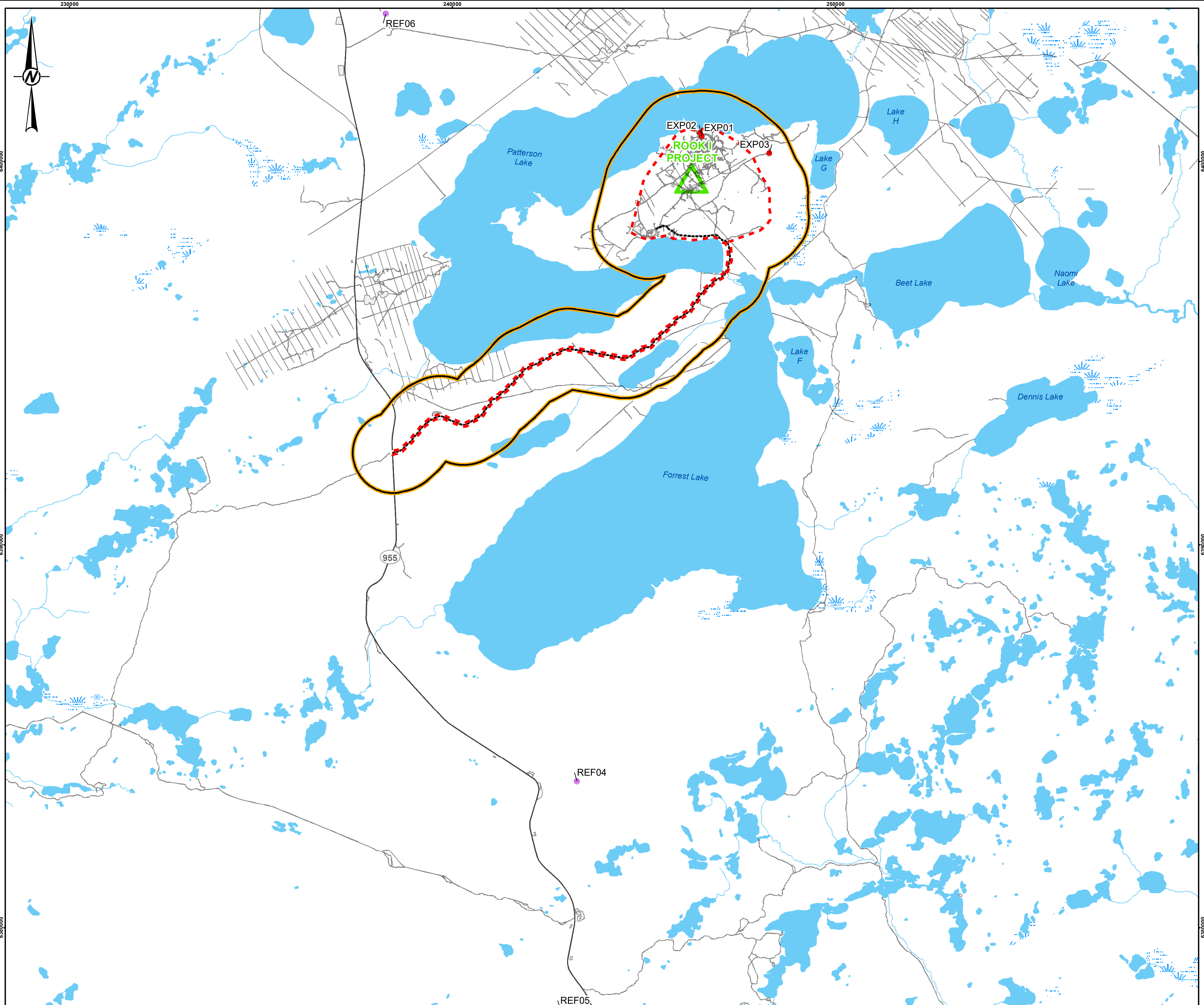
The 2018 baseline field program was completed between 10 October 2018 and 16 October 2018. A total of 112 soil inspection sites were surveyed in 2018, with 96 locations occurring in the maximum disturbance area and 16 in the LSA. In 2019, soil classification and soil sampling were completed between 5 August 2019 and 12 August 2019 at the vegetation plots per the Vegetation Chemistry Characterization Report (Annex VII.3). An additional 30 soil inspection sites were surveyed in 2019 at the vegetation plots. In total, 142 soil inspection sites were surveyed (Figure 4) during the 2018 and 2019 field programs, and terrain and soil data and samples were used for soil classification, mapping descriptions, and chemical analysis.

The following terrain information was collected at each soil inspection site:

- slope gradient, class, position, and length;
- surface expression and terrain/landform; and
- geographic location (by GPS).

At each soil inspection site, detailed profile information was collected to parent material (i.e., C horizon) or to a maximum depth of 120 cm for mineral soils and 2 m for Organic soils. The following soil information was collected at each soil inspection site:

- horizon type, depth, and texture;
- stoniness and roots;
- soil structure, consistence, and colour;
- effervescence and mottling;
- parent material; and
- soil drainage.



LEGEND

- PROJECT LOCATION
- EXISTING ACCESS ROAD
- WATERCOURSE
- WATERBODY
- WETLAND

SOIL SURVEY LOCATIONS

- EXPOSURE PLOT SOIL SURVEY LOCATION
- REFERENCE PLOT SOIL SURVEY LOCATION
- LOCAL STUDY AREA
- MAXIMUM DISTURBANCE AREA
- EXISTING DISTURBANCE

0 2,000 4,000

1:101,000 METRES

REFERENCE(S)

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PROJECTION: UTM ZONE 12 DATUM: NAD 83

CLIENT

NexGen Energy Ltd.

PROJECT

ROOK I PROJECT

TITLE

SOILS AND TERRAIN BASELINE OVERVIEW

CONSULTANT

GOLDER

YYYY-MM-DD	2021-06-09
DESIGNED	JN
PREPARED	PS/NO
REVIEWED	KH
APPROVED	JV

PROJECT NO.	PHASE	REV.	FIGURE
1899581	2002	0	3

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4.2.1 Terrain Analysis and Correlation with Soil Map Units

The terrain analysis component integrated data from the field program to develop soil map units (SMUs) based on soil characteristics and terrain features that captured the range of variability in soil subgroups present within the maximum disturbance area and LSA. At each soil inspection site, the parent material classification was noted and used as a basis for delineating SMUs. Terrain classification was delineated by combining SMUs with similar properties. For example, all SMUs with glaciofluvial parent materials were merged to produce larger units having similar morphological characteristics. Therefore, the terrain unit names reflect surficial material characteristics.

4.2.2 Soil Classification and Mapping

4.2.2.1 Soil Classification and Mapping Guidelines

Based on information obtained during the 2018 field program, soils were classified to the subgroup level according to the *Canadian System of Soil Classification, Third Edition* (SCWG 1998). Brunisolic soils were classified to the great group level based on soil pH of the B horizon. Organic soil profiles were classified based on an organic layer of greater than 40 cm and a dominating organic middle tier. Gleysolic soils were classified based on colour and mottling properties indicated by prolonged periods of saturation (SCWG 1998).

Soil mapping was completed following guidelines outlined in *A Soil Mapping System for Canada: Revised* (Agriculture Canada 1981). Soils were generally grouped into three landscape (i.e., terrain) areas: upland landscape positions for well-drained soils; depressional (Organic) landscape positions for very poorly drained soils; and transition landscape positions (i.e., between upland and wetland positions) for poorly to imperfectly drained soils (possibly exhibiting peaty phase characteristics).

4.2.2.2 Soil Map Unit Designation for the Maximum Disturbance Area and Local Study Area

Soil mapping involved the correlation of field observations and soil classification with publicly available satellite imagery for the extent of the maximum disturbance area and LSA. CanVec (1:50,000) (Government of Canada 2013) topographic data were used to identify general relief and changes in terrain. Soil inspection information was applied considering principles of geomorphology and surficial geology in combination with ground-truthed soil patterns. Soils in the maximum disturbance area were mapped to Survey Intensity Level 1 (SIL1) at 1:5,000 scale, and soils in the LSA were mapped to a 1:20,000 scale, consistent with SIL2 (Valentine and Lidstone 1985).

The primary characteristics used to group soil types into SMUs included dominant soil texture, parent material, soil subgroup, drainage, surface stoniness, and terrain (slope and surface expression). Soil map units (i.e., soil polygons) were created for the maximum disturbance area and LSA after considering relationships between map resources, satellite imagery, and field data. As there are no published soil surveys for the maximum disturbance area and LSA, names for SMUs were assigned based on the dominant parent material (mineral or organic) within the map unit area.

Soil subgroups within SMUs were defined as dominant, sub-dominant, or inclusions based on the proportion of each soil subgroup present in the SMU. Dominant soil subgroups represent the most common soil subgroup within the map unit and typically occupied 60% to 100% of the map unit. Sub-dominant soil subgroups represent a minor proportion of the map unit (typically 20% to 40%). Inclusions represent soil subgroups that occupy a minor amount (approximately 15% to 20%) of the map unit area and are generally found sporadically and infrequently. Soil subgroups that represented less than 15% of the map unit were not mapped.

4.2.3 Soil Chemistry

4.2.3.1 2018 Baseline Program

During the 2018 field survey, samples from each soil horizon (i.e., A, B, and BC/C) of the dominant soil orders (Brunisolic, Gleysolic, Regosolic, and Organic [SCWG 1998]) were collected at five soil inspection sites. Four of the five soil inspection sites were classified within the Brunisolic soil order, and one soil inspection site was classified within the Organic soil order. The samples were analyzed for chemistry and other soil quality properties to confirm the soil subgroup classification. Samples were collected using a trowel and were stored in sealed plastic bags during transport to the Australian Laboratory Services (ALS) and Saskatchewan Research Council (SRC) laboratories. The samples were analyzed for the following parameters:

- potential of hydrogen (pH);
- electrical conductivity (EC);
- sodium adsorption ratio (SAR);
- soluble cations (calcium, magnesium sodium, potassium);
- cation exchange capacity (CEC; A horizon only);
- base saturation; and
- particle size distribution.

Baseline leachable metal chemistry is an indicator of soil quality, which can influence the growth and health, and leachable metal concentrations, in plants. Therefore, samples that were collected at the five soil inspection sites were also analyzed for a suite of leachable metals (i.e., aluminum, antimony, arsenic, barium, beryllium, bismuth, boron, cadmium, chromium, cobalt, copper, iron, lead, lithium, manganese, mercury, molybdenum, nickel, selenium, silver, strontium, thallium, tin, titanium, tungsten, uranium, vanadium, zinc, and zirconium) for each horizon.

4.2.3.2 2019 Exposure and Reference Vegetation Plots Program

In the 2019 field survey, soil samples were collected at the same locations as baseline vegetation chemistry samples to provide integration between the two baseline components and to meet potential requirements for future long-term effects monitoring programs. Exposure (EXP) and Reference (REF) vegetation plots [2] were pre-selected where suitable habitat most likely to support both blueberry and lichen species intersected with either the dominant (south-southeast) or subdominant (west) wind direction. Soil samples for metal and radionuclide analyses were collected at the same exposure and reference sites (Figure 3).

Three exposure sampling sites and three reference sampling sites were identified. The three exposure sites are located within the LSA (two within and one outside the maximum disturbance area) to capture potential Project-related effects.

[2] The exposure area encompassed sampling sites within 1 km of the anticipated Project footprint; the reference area encompassed sampling sites beyond 5 km from the anticipated Project footprint. Vegetation chemistry sampling is discussed further in the *Vegetation Chemistry Baseline Report*.

The three reference sites are located outside of the LSA and approximately 750 m from Highway 955 to limit the effects of dust deposition from the highway, while still allowing accessibility for long-term monitoring.

Between 6 August 2019 and 12 August 2019, a composite sample consisting of three subsamples of the topsoil horizons (surface organic and A horizons) was collected at each of the exposure and reference sites. The composite samples were analyzed for the following parameters:

- potential of hydrogen (pH);
- electrical conductivity (EC);
- sodium adsorption ratio (SAR);
- soluble cations (calcium, magnesium sodium, potassium);
- cation exchange capacity (CEC; A horizon only);
- base saturation; and
- leachable metal concentrations.

Radionuclides (i.e., lead-210, polonium-210, radium-226, thorium-228, thorium-230, and thorium-232) were sampled in the 2019 field survey as a baseline for a potential long-term effects monitoring program and to provide data for the ecological risk assessment.

4.2.4 Soil Suitability for Reclamation

Soil physical and chemical characteristics were used to estimate soil limitations for reclamation. Soil field observations and analytical results were compared to the criteria for evaluating the suitability of topsoil material (i.e., upper lift) and the suitability of subsoil material (i.e., lower lift) for re-vegetation in the Northern Forest Region, as outlined by the Alberta Soil Advisory Committee in *Soil Quality Criteria Relative to Disturbance and Reclamation* (Alberta Agriculture 1987). Soil reclamation suitability interpretations for individual map units were based on the specific physical and chemical characteristics. Reclamation suitability classes were determined for the topsoil material (upper lift) based on modal characteristics and average depths of Litter (L), Fermented (H), Humus (H) (Agriculture Canada 1982), and A horizons. The topsoil typically captures soil characteristics within the top 30 cm of the soil profile (Alberta Agriculture 1987). Reclamation suitability classes for the subsoil material (lower lift) were determined based on modal characteristics and average depths of B, BC, and C horizons to a depth of 1 m.

Parameters such as coarse soil textures, stoniness/rockiness, moisture content, and soil reaction (i.e., pH) tend to limit soil reclamation suitability. For example, soils that are gravelly (with more than 50% coarse fragments) and coarse textured (loamy sand to sand) are generally considered unsuitable or poor for reclamation purposes. The specific end land use can also affect the reclamation suitability rating. For example, certain factors that may be a limitation for agriculture may not be a limitation for forestry. Where pH may be a limitation, the limits presented are pertinent to both the reclamation objective, such as erosion control, and the eventual end land use (Alberta Agriculture 1987). The criteria used to rank reclamation suitability are presented in Table 1 and Table 2. The most limiting property (i.e., rating) determines the ultimate reclamation suitability rating for each horizon or layer.

Table 1: Reclamation Suitability of Topsoil Material for Re-vegetation

Rating/Property	Good	Fair	Poor	Unsuitable
Reaction (pH)	5.0-6.5	4.0-5.0, 6.5-7.5	3.5-4.0, 7.5-9.0	<3.5, >9.0
Salinity (EC) (dS/m)	<2	2-4	4-8	>8
Sodicity (SAR)	<4	4-8	8-12	>12
Saturation (%)	30-60	20-30, 60-80	15-20, 80-120	<15, >120
Stoniness/Rockiness (% area)	<30 / <20	30-50 / 20-40	50-80 / 40-70	>80 / >70
Texture[(a)]	fSL, vfSL, L, SiL, SL	CL, SCL, SiCL	LS, SiC, C, HC, S	n/a
Moist consistency	Very friable, friable	Loose, firm	Very firm	Extremely firm
$CaCO_3$ equivalent (%)	<2	2-20	20-70	>70

Source: Adapted from Table 8. Criteria for Evaluating the Suitability of Surface Material (Upper Lift) for Re-Vegetation in the Northern Forest Region (Alberta Agriculture 1987).
a) C = clay; CL = clay loam; fSL = fine sandy loam; HC = heavy clay; L = loam; LS = loamy sand; S = sand; SCL = sandy clay loam; SiC = silty clay; SiCL = silty clay loam; SL = sandy loam; SiL = silt loam; vfSL = very fine sandy loam.
$CaCO_3$ = calcium carbonate; EC = electrical conductivity; dS/m = decisiemens per metre; n/a = not applicable; SAR = sodium adsorption ratio; < = less than; > = greater than.

Table 2: Reclamation Suitability of Subsoil Material for Re-vegetation

Rating/Property	Good	Fair	Poor	Unsuitable
Reaction (pH)	5.0-7.0	4.0-5.0, 7.0-8.0	3.5-4.0, 7.5-9.0	<3.5, >9.0
Salinity (EC) (dS/m)	<3	3-5	4-8	>8
Sodicity (SAR)	<4	4-8	8-12	>12
Saturation (%)	30-60	20-30, 60-80	15-20, 80-100	<15, >100
Stoniness/Rockiness (% area)	<30 / <15	30-50 / 15-30	50-70 / 30-50	>70 / >50
Texture[(a)]	fSL, vfSL, L, SiL, SL	CL, SiC, SiCL	LS, C, HC, S	Bedrock
Moist consistency	Very friable, friable, firm	Loose, very firm	Extremely firm	Hard rock
$CaCO_3$ equivalent (%)	<5	5-20	20-70	>70

Source: Adapted from Table 9. Criteria for Evaluating the Suitability of Subsurface Material (Lower Lift) for Re-Vegetation in the Northern Forest Region (Alberta Agriculture 1987).
a) C = clay; CL = clay loam; fSL = fine sandy loam; HC = heavy clay; L = loam; LS = loamy sand; S = sand; SCL = sandy clay loam; SiC = silty clay; SiCL = silty clay loam; SL = sandy loam; SiL = silt loam; vfSL = very fine sandy loam.
$CaCO_3$ = calcium carbonate; EC = electrical conductivity; dS/m = decisiemens per metre; n/a = not applicable; SAR = sodium adsorption ratio; < = less than; > = greater than.

4.2.5 Soil Sensitivities in the Local Study Area

Soil sensitivities that have the potential to affect soil quality include erosion, acidification, permafrost, and compaction. Changes to soil quality may influence the ability of soil to support vegetation.

4.2.5.1 Water and Wind Erosion Sensitivities

The risk of soil erosion from water or wind is influenced by many factors, including soil particle size, organic matter content, water content, permeability, topography, slope gradient, vegetation cover, natural events (e.g., freeze-thaw), and human activities that cause soil disturbance (Cruse et al. 2001; Campbell et al. 2002; TAC 2005).

Erosion from water and wind differ by the processes that move detached soil particles, and each process of erosion affects soil differently. The outcome of soil erosion is important because of potential effects that could be caused beyond the potentially eroded area. These effects could include sedimentation of adjacent waterbodies and the release of chemicals from the soil into surface water, which may alter water quality (Kuhn and Bryan 2004).

Soil erosion risk is one of the primary concerns for disturbed soils because the removal of vegetation cover exposes soil materials to wind and water. Depending on terrain and soil characteristics, with continuous exposure of soil to wind or rain, soil materials may be eroded, washed, or blown away, and may result in the loss of uppermost material (topsoil) and a reduction in soil quality.

Water and wind erosion sensitivity ratings were assigned to SMUs within the maximum disturbance area and LSA and are described in more detail in Section 4.2.5.1.1, Water Erosion Sensitivity and Section 4.2.5.1.2, Wind Erosion Sensitivity.

4.2.5.1.1 Water Erosion Sensitivity

The potential for soil erosion by water is affected by soil texture, organic matter content, water content, permeability, topography, slope gradient, and vegetation cover. Finer textured clayey soils tend to be less prone to erosion by water than silty soils (TAC 2005), especially when the soil structure has been disturbed by freeze-thaw or human activity (Cruse et al. 2001). The higher permeability of sandy-textured soils contributes to a lower potential for over-land flow of water, thus decreasing the potential for soil erosion. In areas where slope gradient and slope length increases, so does the potential for soil erosion regardless of soil texture.

Determining soil erosion potential by water was based on methods described by Transportation Association of Canada (TAC 2005). Water erosion ratings and potentials were assigned to SMUs within the maximum disturbance area and LSA based on characteristics of terrain and soils (i.e., slope length, gradient, and topsoil texture) recorded during the 2018 and 2019 field programs (Table 3). The uppermost mineral soil horizon textures of soil subgroups were used to determine the water erosion rating as the first step in determining water erosion potential. Soils are categorized as having High, Medium, or Low sensitivity ratings (Table 3). The water erosion potential was then determined based on the water erosion rating, dominant slope class, and dominant slope length (Table 4). Water erosion potentials were then assigned to map units within the maximum disturbance area and LSA. In areas where slope gradient increased, so did the potential for soil erosion regardless of soil texture. Water erosion potentials were based on bare, unprotected soils.

Table 3: Criteria for Determining Water Erosion Rating

Soil Texture	Water Erosion Rating
Silt, silty loam, loam	High
Sandy loam, silt clay loam, sandy clay loam, silty clay, clay loam[a]	Medium
Sandy clay, clay, heavy clay, loamy sand, sand	Low

Source: Adapted National Guide to Erosion and Sediment Control on Roadway Projects (TAC 2005).
a) Clay loam is not present in TAC (2005); however, clay loam has been included in the Medium range as it is coarser than clay (Low) and finer than silt clay (High) in the texture triangle (SCWG 1987).

Table 4: Criteria for Determining Water Erosion Potential

Slope Gradient	Water Erosion Rating[a]	Slope Length	
		<70 m	>70 m
0% to 10%	Low	Low	Low
	Medium	Low	Moderate
	High	Moderate	High
10% to 20%	Low	Low	Moderate
	Medium	Moderate	High
	High	High	High
>20%	Low	Moderate	Moderate
	Medium	High	High
	High	High	High

Source: Adapted from Table 4-2 in the National Guide to Erosion and Sediment Control on Roadway Projects (TAC 2005; City of Calgary 2011).
a) determined from Table 3.
< = less than; > = greater than.

4.2.5.1.2 Wind Erosion Sensitivity

The potential for soil erosion by wind is affected by vegetation cover, wind velocity, soil water content, and soil texture. In general, coarse (i.e., sandy) textured soils are more prone to wind erosion than finer (i.e., clay) textured soils (Coote and Pettapiece 1989). Sandy-textured soils typically do not have a well-developed soil structure. The lack of soil structure is due to limited soil aggregation or adhesion of the soil particles, which does not allow the formation of larger and more stable soil aggregates that are less likely to be moved by wind. Organic soils are typically less prone to wind erosion unless they have dried out or are disturbed (Campbell et al. 2002). Wind erosion of Organic soils is a function of the degree of peat decomposition; thus, the more highly decomposed the organic soil is, the greater the risk for wind erosion.

Wind erosion ratings were assigned to the SMUs within the maximum disturbance area and LSA (Table 5). Mineral soil sensitivity was based on the topsoil horizon texture and a dimensionless index described by Coote and Pettapiece (1989) (Table 5). Wind erosion ratings for Organic soils were assigned based on degree of peat decomposition (Campbell et al. 2002) (Table 5). Wind erosion ratings were based on disturbed, bare soils for mineral soils and on dry, disturbed conditions for Organic soils.

Table 5: Criteria for Determining Wind Erosion Rating

Soil Texture	Wind Erosion Rating
Very fine sand, sand, coarse sand, loamy sand, gravelly sand, humic	High
Sandy loam, loam, silty loam, sandy clay loam, sandy clay, mesic	Moderate
Silt, silty clay loam, clay loam, silty clay, clay, heavy clay, fibric	Low

Source: Adapted from Coote and Pettapiece (1989) and Campbell et al. (2002).

4.2.5.2 Soil Sensitivity to Acidification

Soil sensitivity to acidification is a measure of soil's susceptibility to experience a decrease in pH after experiencing acid inputs. Soil sensitivity to acidification is inversely related to soil buffering capacity.

The SMUs in the maximum disturbance area and LSA were rated for sensitivity to acidification (Table 6), with ratings being based on the sensitivity to the loss of basic cations (primarily calcium, magnesium, and potassium), sensitivity to acidification, and sensitivity to solubilization of aluminum.

The sensitivity of mineral soils to acidification was evaluated using the chemical criteria published by Holowaychuk and Fessenden (1987) (Table 6). In general, neutral to alkaline mineral soils with pH values greater than 6.5 have a lower sensitivity to acidification because of an increased buffering capacity (Holowaychuk and Fessenden 1987). As CEC increases, the associated soil pH can be less and remain less sensitive to acidic inputs. Soils that are high in clay and organic matter content were characterized as having a higher CEC, and therefore a Low sensitivity to acidification.

Table 6: Criteria for Rating the Sensitivity of Mineral Soils to Acidic Inputs

Cation Exchange Capacity (mEq/100 g)	pH	Overall Sensitivity
<6	<4.6-6.5	High
	>6.5	Low
6 to 15	<4.6	High
	4.6-6.0	Moderate
	>6.0	Low
>15	<4.6	High
	4.6-5.5	Moderate
	>5.6	Low

Source: Modified from Holowaychuk and Fessenden 1987.
mEq/100 g = milliequivalents of ammonium cation adsorbed by 100 grams of dry soil; < = less than; > = greater than.

Selected soil samples collected during the 2018 field program were analyzed for CEC. Samples that were not submitted for laboratory CEC analysis were supplemented with CEC ranges derived from data presented in Holowaychuk and Fessenden (1987) and soil texture (Table 7) to estimate the sensitivities of soils to acidification. For soil samples where pH was obtained along with CEC, the values were considered in the determination of acidification sensitivity.

Table 7: Cation Exchange Capacity Relationship to Soil Texture

Texture	Typical Range of Cation Exchange Capacities (mEq/100 g)
Sand and loamy sand	<6
Sandy loam	6-15
Loam and silt loam	12-22
Clay loam and silty clay loam	20-30
Clay	25-45

Source: Derived from soil data presented in Holowaychuk and Fessenden 1987.
mEq/100 g = milliequivalents of ammonium cation adsorbed by 100 grams of dry soil; < = less than; > = more than.

The sensitivity rating for Organic soil was based on the type of wetland (e.g., bog, poor fen, moderate-rich fen, and extreme-rich fen) (Turchenek et al. 1998).

These criteria are based on the pH, CEC, and base saturation of the surface layer of organic soil in each wetland type, as well as the pH and base cation content of the associated pore water.

In general, moderate-rich and extreme-rich fens (i.e., Organic soils with moderate to high nutrient status and neutral pH or higher) tend to be least susceptible to acidification (Table 8). In moderate-rich fens, water supply comes from surface water or groundwater, which is typically mineral-rich and neutral in pH. Fens are not hydrologically isolated, and therefore receive mineral-rich surface or groundwater, which influences the soil pH and nutrient content. Due to incoming water, the acid buffering capacity is replenished, and water is eventually discharged from the wetland through lateral flow. Organic soils that occur in moderate-rich fens are least susceptible to acidification and therefore have a Low sensitivity rating (Table 8).

Table 8: Criteria for Rating the Sensitivity of Wetland Soils to Acidic Inputs

Wetland Type	Sensitivity to:		Overall Sensitivity Rating
	Base Loss	Acidification	
Extreme-rich fen	Low	Low	Low
Moderate-rich fen	Low to Moderate	Low	Low
Bog and poor fen	Moderate to High	Moderate	Moderate

Source: Turchenek et al. 1998.

Bogs are hydrologically isolated; all water in bogs comes from precipitation falling on the bog itself, and thus bogs are very low in nutrients and more acidic than fens. In addition, a larger volume of organic (i.e., peat) material is present at the surface of bogs that can react with incoming acidity. Poor fens, although slightly higher in nutrient status and pH than bogs, represent an ecosite between bogs and rich fens. Peat accumulation in poor fens is ongoing, and influence of underlying mineral material is reduced as compared to richer fen types. In poor fens, there is less material present to react with incoming acidity, and buffering capacity may not be replenished as quickly through water inputs. Organic soils that occur in bogs and in poor fens are most susceptible to acidification and therefore have a Moderate sensitivity rating (Table 8).

4.2.5.3 Permafrost Potential

Permafrost is defined as permanently frozen soil or rock and incorporated ice and organic material that remains at or below 0°C for a minimum of two years due to natural climatic factors (van Everdingen 1998). The distribution and thickness of permafrost is influenced by various factors including climate, topography, peat thickness, winter snow accumulation, hydrology, and subsurface geology (Williams and Burn 1996). Peat thickness, vegetation cover, micro-topography (i.e., presence of hummocks), and moisture content are important variables in predicting the presence of permafrost (Williams and Burn 1996).

Permafrost soils are sensitive to ground disturbances as changes to topsoil materials can alter the soil thermal regime and result in warming of the soil to a greater depth, causing persistent ice to melt (Hayhoe and Tarnocai 1993). This melting can result in differential thaw settling, slumping, and increased wind and water erosion potential (Burgess and Harry 1990; Hayhoe and Tarnocai 1993). The potential effects of disturbance on permafrost soils depends on soil ice content, soil type, drainage, and vegetative cover (Magnusson and Stewart 1987). Organic soils in wetlands are particularly sensitive to disturbance and the melting of ice because of the low bulk densities and potentially high ice content (Magnusson and Stewart 1987).

However, depressional topography, high moisture content, dense vegetation cover, thickness of snow cover, and thickness of surface organic matter can have an insulating effect on permafrost (i.e., keep it frozen) (Judge 1973; Tarnocai 1984; Zoltai 1995; Williams and Burn 1996).

Permafrost potential ratings for each soil subgroup within the maximum disturbance area and LSA were assigned based on drainage, soil texture, and topography observed during the 2018 and 2019 field programs. Fine-textured soils with poor to imperfect drainage were rated as having a Low to Moderate permafrost potential, whereas coarse-textured soils with moderate to rapid drainage were rated as having a Very Low potential for permafrost. If present, Cryosolic soils were rated as having a High potential for permafrost.

4.2.5.4 Sensitivity to Compaction

Soil capability to support vegetation can be reduced if soil becomes compacted. Soil compaction can also influence reclamation success by altering plant establishment and subsequent plant growth. Compaction of topsoil (A horizon) and subsoil (B horizon and C horizons) can lead to a decrease in long-term productivity because of an increase in soil bulk density and soil strength, reductions in soil aeration and soil oxygen, reduced water infiltration and available soil water, restricted root growth, reductions in soil microbiological activity, and lowered nutrient uptake by vegetation (Heuer et al. 2008; Blouin et al. 2008).

Generally, well-drained, coarse- and medium-textured soils (i.e., loams, sandy loam, loamy sand, loam) are less prone to compaction than fine-textured soils (i.e., silty clay loam, silty clay, clay loam, and clay). However, sensitivity to compaction can change based on soil moisture conditions (Lewis et al. 1989). For example, loamy-textured soils under wet conditions are more prone to compaction than the same soil texture under dry conditions. In finer-textured soil (i.e., clayey), saturated conditions may exist due to poor drainage (i.e., the smaller soil pore sizes related to these textures can reduce water movement through the soil), and as soil moisture increases, so does soil sensitivity to compaction.

Compaction ratings for SMUs in the maximum disturbance area and LSA were determined under moist soil conditions using the criteria outlined in Table 9. Gleysolic soils and the associated peaty phases were assigned compaction ratings based on soil texture under wet (saturated) soil conditions. Organic soils were not assigned compaction ratings.

Table 9: Criteria for Determining Compaction Ratings of Soils

Soil Texture	Compaction Rating[a]		
	Dry	Moist	Wet
Sandy (sand, loamy sand)	Low	Low	Moderate
Loamy (sandy loam, loam)	Low	Moderate	High
Silty (silt, silty loam)	Moderate	High	Very High
Clayey (sandy clay, silty clay, sandy clay loam, clay loam, silty clay, clay)	High	Very High	Very High

Source: Modified from Lewis et al. 1989.
a) Based on a coarse fragment content of less than 35% (if coarse fragment content is between 35% and 70% loamy and silty are grouped together and compaction rating is moderate, and clayey is high).

4.3 Quality Assurance and Quality Control

Quality assurance (QA) and quality control (QC) practices determine data integrity and are relevant to all aspects of the study, from sample collection to data analysis and reporting. The QA encompasses management and technical practices designed to confirm that the data generated are of consistent high quality. The QC is an aspect of QA and includes the procedures used to measure and evaluate data quality, and the corrective actions to be taken when data quality objectives are not met.

4.3.1 Quality Assurance

Quality assurance applicable to this study covers internal and external management. One field crew member was responsible for managing the sample shipping process for the field program to confirm that samples were properly labelled, documentation was completed, and samples were delivered to the laboratory in a timely manner. The other member of the field crew was designated as the laboratory liaison. The laboratories selected for the analysis of the 2018 and 2019 samples were ALS and SRC, respectively. Both ALS and SRC are accredited by the Canadian Association for Laboratory Accreditation Inc. (CALA). Under CALA's accreditation program, performance evaluation assessments are conducted annually for laboratory procedures, methods, and internal quality control. The ALS Laboratory Group certificate of analysis and the SRC laboratory Quality Control Report are included in Appendix B Chemical Analysis Results.

Internal QA included use of appropriately trained personnel for each task and senior review of work products at appropriate milestones, use of standardized data manipulation/summary tools, and filing of data and Project information according to standardized protocols.

4.3.2 Quality Control

The QC program consisted of the collection and analysis of field replicate samples, and laboratory QC analysis. Laboratory QC analysis included a variety of techniques, such as the analysis of reference materials, control samples, and spike recovery measurements to verify the validity of the analytical results. If QC issues were identified, the samples were re-analyzed, or other corrective action was undertaken to demonstrate that the analytical results were within the expected measurement uncertainty.

5.0 RESULTS

Of the 112 soil inspection sites surveyed in the maximum disturbance area and LSA in 2018, 106 soil inspection sites were classified to be mineral soils (94.6%), and 6 soil inspection sites were classified as Organic soils (5.4%). In 2019, the six soil inspection sites surveyed at the reference and exposure sites (Section 4.1.2) were all classified as mineral soils. Terrain and soils information for all soil inspection sites are available in Appendix C Soils Inspection Site Data.

5.1 Terrain

During the 2018 and 2019 field programs, it was observed that the terrain in most of the maximum disturbance area and LSA comprised undulating to hummocky upland landscape with high relief and dominant surface stoniness class of Very Stony (i.e., 3% to 15% of ground surface covered). Soil inspections during the surveys indicated that the maximum disturbance area and LSA predominantly consist of loamy sand textured soils formed from glaciofluvial parent material and outwash depositional settings.

5.1.1 Parent Material Classification

Parent material types were derived from the genetic composition of landform classification in the CanSIS (Agriculture Canada 1982). The CanSIS parent material types were used to delineate glaciofluvial parent materials and organic fens as terrain units. Parent material types and associated terrain units, and the associated total distributions within LSA (entirely containing the maximum disturbance area), are summarized in Table 10. The dominant terrain unit in the LSA is glaciofluvial and accounts for 3,303.6 ha (72.5%). The fen peat terrain unit (organic) accounts for 245.7 ha (5.4%) of the LSA. The water map unit accounts for 904.6 ha (19.8%) of the LSA and includes areas with open water on a year-round basis. The existing anthropogenic (i.e., human-based) disturbance unit accounts for 105.7 ha (2.3%) of the and LSA and includes features such as roads, cutlines and clearings, public trails, Highway 955, and infrastructure associated with the Rook I exploration site.

Table 10: Distribution of Terrain/Map Units in the Local Study Area

Terrain Units	Area	
	(ha)	(%)
Glaciofluvial	3,303.6	72.5
Fen peat	245.7	5.4
Water	904.6	19.8
Existing anthropogenic disturbance	105.7	2.3
Total	**4,559.6**	**100.0**

Note: Some numbers are rounded for presentation purposes. Therefore, it may appear that the totals do not equal the sum of the individual values.

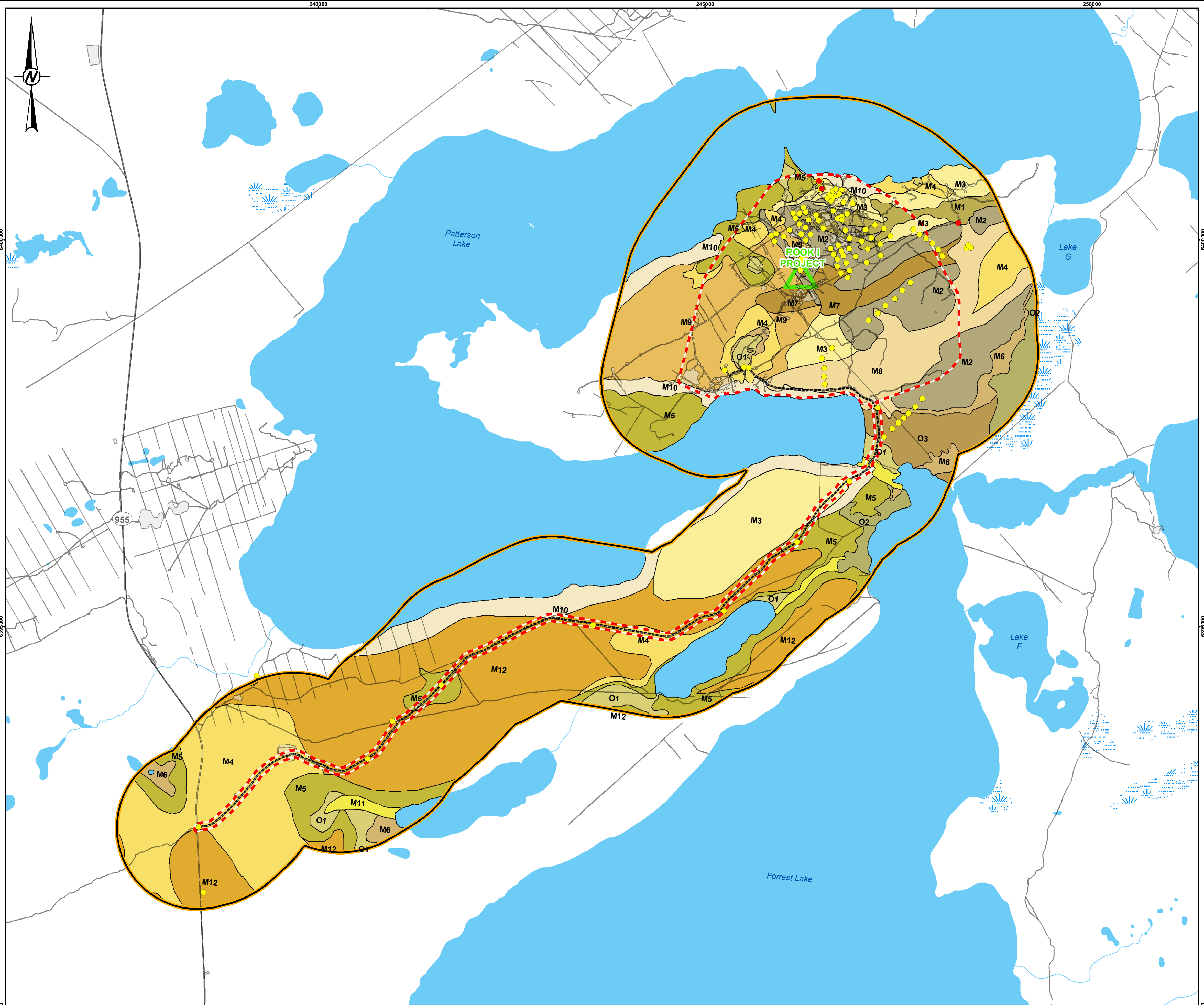
5.2 Soils

Soils in this landscape are dominantly Brunisolic soils that have been developed on sandy glacial till deposits (Acton et al. 1998). Lower areas and depressions in the landscape are typically poorly drained and contain Organic and Gleysolic soils. Within the Fort Hills Landscape Area, the surficial deposits are predominantly loamy sand glacial tills and glaciofluvial deposits; however, glacial tills were not identified within the Project LSA. Organic deposits are found above sandy tills in local depressional areas (Acton et al. 1998).

Brunisolic soils were generally found at upland landscape positions. The one soil inspection site, at which Gleysolic soil were found, was in a transition area between an upland landscape position and a depressional landscape position (i.e., wetlands). The Organic soils were found in depressional areas.

Soils classified within the Brunisolic order include Eluviated Dystric Brunisol and Gleyed Eluviated Brunisol. The one soil inspection site classified within the Gleysolic order was classified as an Orthic Gleysol. Soils classified within the Organic order included Mesic Fibrisol, Fibric Mesisol, Terric Mesisol, and Terric Humisol.

Soil mapping was completed within the maximum disturbance area and LSA, 15 SMUs have been delineated based on soil characteristics and terrain features that capture the range of variability in soil subgroups present (Figure 4). The 15 SMUs include 12 mineral map units—Mineral-1 (M1) through Mineral-12 (M12)—and three Organic SMUs—Organic-1 (O1), Organic-2 (O2), and Organic-3 (O3).



LEGEND

- PROJECT LOCATION
- EXISTING ACCESS ROAD
- SECONDARY HIGHWAY
- WATERCOURSE
- WATERBODY
- WETLAND
- SOIL SURVEY LOCATION
- EXPOSURE PLOT SOIL SURVEY LOCATION
- LOCAL STUDY AREA
- MAXIMUM DISTURBANCE AREA
- EXISTING DISTURBANCE

SOIL MAP UNITS

- M1
- M2
- M3
- M4
- M5
- M6
- M7
- M8
- M9
- M10
- M11
- M12
- O1
- O2
- O3
- WATER

0 1,000 2,000

1:50,000 METRES

REFERENCE(S)

1. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.

PROJECTION: UTM ZONE 12 DATUM: NAD 83

CLIENT

NexGen Energy Ltd.

PROJECT

ROOK I PROJECT

TITLE

SOIL MAP UNITS AND SURVEY LOCATIONS WITHIN THE MAXIMUM DISTURBANCE AREA AND LOCAL STUDY AREA

CONSULTANT

GOLDER

YYYY-MM-DD	2021-06-10
DESIGNED	JN
PREPARED	NO
REVIEWED	KH
APPROVED	JV

PROJECT NO.	PHASE	REV.	FIGURE
1899581	2002	0	4

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

25mm

Soil mapping was completed within the maximum disturbance area and the LSA. Since the LSA contains the maximum disturbance area entirely, the following discussion of SMUs uses the boundaries of the LSA. Detailed descriptions of the distribution (%) and area (ha) of each SMU within LSA are provided in Table 11. There is approximately 904.6 ha (19.8%) of water delineated within the LSA, as well as 105.7 ha (2.3%) of existing anthropogenic disturbances. The majority (72.5%) of the LSA is composed of mineral SMUs, with the M12 SMU encompassing the largest proportion of the LSA (893.0 ha or 19.6%). The M11 SMU covers the smallest area of the LSA (32.3 ha or 0.7%). There is approximately 245.7 ha (5.4%) of Organic SMUs within the LSA.

Table 11: Description and Distribution of Soil Map Units within the Local Study Area

Soil Map Unit Name (Map Unit Symbol)	Proportion of LSA		Soil Subgroups in the Soil Map Unit[a]	Landform	Stoniness (% of surface covered)	Texture
	Area (ha)	Percent (%)				
Mineral-1 (M1)	49.4	1.1	**Dominantly** Eluviated Dystric Brunisols	Hummocky and ridged – high relief	15-50	Loamy sand
Mineral-2 (M2)	286.2	6.3	**Dominantly** Eluviated Dystric Brunisols **Inclusions** of Gleyed Eluviated Dystric Brunisols	Undulating and rolling	0.1-15	Loamy sand, sand
Mineral-3 (M3)	314.8	6.9	**Dominantly** Eluviated Dystric Brunisols **Inclusions** of Gleyed Eluviated Dystric Brunisols	Hummocky and ridged – high relief	15-50	Sand
Mineral-4 (M4)	508.0	11.1	**Dominantly** Eluviated Dystric Brunisols **Sub-dominantly** Gleyed Eluviated Dystric Brunisols **Inclusions** of Gleysolic soils	Nearly level to undulating	0.1-15	Loamy sand, sand, and sandy loam
Mineral-5 (M5)	395.2	8.7	**Dominantly** Gleyed Eluviated Dystric Brunisols **Sub-dominantly** Eluviated Dystric Brunisols **Inclusions** of Gleysolic soils and Terric Mesisols	Undulating	0.1-15	Loamy sand, sand
Mineral-6 (M6)	69.5	1.5	**Dominantly** Orthic Gleysols **Sub-dominantly** Terric Mesisols **Inclusions** of Gleyed Eluviated Dystric Brunisols	Level to nearly level	<0.01-15	Loamy sand, sand
Mineral-7 (M7)	71.8	1.6	**Dominantly** Eluviated Dystric Brunisols **Inclusions** of Gleyed Eluviated Dystric Brunisols	Hummocky and ridged – low relief	0.1-3	Loamy sand
Mineral-8 (M8)	196.1	4.3	**Dominantly** Eluviated Dystric Brunisols **Inclusions** of Gleyed Eluviated Dystric Brunisols	Hummocky and ridged – high relief	15->50	Loamy sand
Mineral-9 (M9)	260.6	5.7	**Dominantly** Eluviated Dystric Brunisols **Sub-dominantly** Gleyed Eluviated Dystric Brunisols	Undulating to low relief	0.1-15	Loamy sand, sand
Mineral-10 (M10)	226.8	5.0	**Dominantly** Eluviated Dystric Brunisols **Inclusions** of Gleyed Eluviated Dystric Brunisols	Inclined to level	3-15	Sandy loam

Table 11: Description and Distribution of Soil Map Units within the Local Study Area

Soil Map Unit Name (Map Unit Symbol)	Proportion of LSA		Soil Subgroups in the Soil Map Unit[(a)]	Landform	Stoniness (% of surface covered)	Texture
	Area (ha)	Percent (%)				
Mineral-11 (M11)	32.3	0.7	**Dominantly** Gleyed Eluviated Dystric Brunisols **Sub-dominantly** Eluviated Dystric Brunisols and Gleysolic soils; **Inclusions** of Terric Mesisols	Associated with watercourses and drainage channels	<0.01-15	Loamy sand, sand
Mineral-12 (M12)	893.0	19.6	**Dominantly** Eluviated Dystric Brunisols; **Inclusions** of Gleyed Eluviated Dystric Brunisols and Gleysolic soils	Undulating and rolling	0.01-3	Loamy sand, sand, and sandy loam
Organic-1 (O1)	78.5	1.7	**Dominantly** Terric Mesisols; **Inclusions** of Gleysolic soils	Level to nearly level	<0.01	n/a, sand, loamy sand
Organic-2 (O2)	80.2	1.8	**Dominantly** Typic Mesisols; **Inclusions** of Terric Mesisols	Level to nearly level	<0.01	n/a
Organic-3 (O3)	87.0	1.9	**Dominantly** Typic Mesisols **Sub-dominantly** Terric Mesisols; **Inclusions** of Gleysolic soils and Gleyed Eluviated Dystric Brunisols	Level with mineral soil hummocks	<0.01	n/a, loamy sand
Water	904.6	19.8	n/a	n/a	n/a	n/a
Existing anthropogenic disturbance	105.7	2.3	n/a	n/a	n/a	n/a
Total	**4,559.6**	**100.0**	**n/a**	**n/a**	**n/a**	**n/a**

Note: Some numbers are rounded for presentation purposes. Therefore, it may appear that the totals do not equal the sum of the individual values.
a) Dominant soil subgroup(s) = cover 60% to 100% of the soil map unit area; co-dominant soil subgroup(s) = near equal proportion of the soil map unit area covered; sub-dominant soil subgroup(s) = cover 20% to 40% of the soil map unit area; inclusions = cover 15% to 20% of the soil map unit area. The LSA includes the maximum disturbance area and is based on a 1 km buffer around the maximum disturbance area.
LSA = local study area; n/a = not applicable.

5.2.1 Soil Map Unit Characteristics

5.2.1.1 Mineral Soil Map Units

The mineral SMUs combined make up approximately 3,303.6 ha (72.5%) of the LSA. The mineral SMUs differ from one another based on the distribution of dominant or co-dominant upland (i.e., mineral) soils, inclusions of mineral soils, and/or inclusions of wetland (i.e., Organic) or transition (i.e., mineral or peaty phase mineral) soils. The mineral SMUs also differ based on terrain and soil development such as slope class range, drainage, and surface stoniness. The SMU characteristics are described in more detail in Appendix D Soil Map Characteristics.

Mineral-1 (M1)

The M1 SMU covers approximately 49.4 ha (1.1%) of the LSA. The M1 SMU consists of rapidly drained to moderately well-drained Eluviated Dystric Brunisols developed on hummocky and high relief ridged topography (i.e., >2% to 30% slopes). The SMU also contains moderately coarse (i.e., loamy sand) glaciofluvial materials that are exceedingly stony to excessively stony (i.e., 15% to >50% of surface covered).

Mineral-2 (M2)

The M2 SMU covers approximately 286.2 ha (6.3%) of the LSA. The M2 SMU dominantly consists of rapidly drained to moderately well-drained Eluviated Dystric Brunisols developed on undulating and rolling landscapes (i.e., >2% to 15% slopes). The SMU contains moderately coarse to coarse textured (i.e., loamy sand, sand) glaciofluvial materials that are moderately stony to very stony (i.e., 0.1% to 15% of surface covered). Inclusions of Gleyed Eluviated Dystric Brunisols may also occur at lower slope positions within the SMU.

Mineral-3 (M3)

The M3 SMU covers approximately 314.8 ha (6.9%) of the LSA. The M3 SMU dominantly consists of rapidly drained Eluviated Dystric Brunisols developed on hummocky and high relief ridged landscapes (i.e., >5% to 45% slopes). The SMU contains coarse-textured (i.e., sand) glaciofluvial materials that are exceedingly stony to excessively stony (i.e., 15% to >50% of surface covered). Inclusions of Gleyed Eluviated Dystric Brunisols may also occur at lower slope positions within the SMU.

Mineral-4 (M4)

The M4 SMU covers approximately 508.0 ha (11.1%) of the LSA. The M4 SMU dominantly consists of moderately well to imperfectly drained Eluviated Dystric Brunisols developed on nearly level to undulating landscapes (i.e., 0% to 5% slopes). The SMU contains moderately coarse to coarse textured (i.e., loamy sand, sand, sandy loam) glaciofluvial materials that are moderately stony to very stony (i.e., 0.1% to 15% of surface covered). In addition, the SMU sub-dominantly consists of Gleyed Eluviated Dystric Brunisols that are generally found at lower slope positions. Inclusions of imperfectly to poorly drained Gleysolic soils developed on moderately coarse textured (i.e., loamy sand) glaciofluvial material may also occur within the SMU and are generally found in the lower slope positions, swales between undulations, hummocks, or ridges, and in transitions to areas of poor drainage.

Mineral-5 (M5)

The M5 SMU covers approximately 395.2 ha (8.7%) of the LSA. The M5 SMU dominantly consists of moderately well drained Gleyed Eluviated Dystric Brunisols developed on undulating landscapes (i.e., >0.5% to 5% slopes). The SMU contains moderately coarse to coarse textured (i.e., loamy sand, sand) glaciofluvial materials that are moderately stony to very stony (i.e., 0.1% to 15% of surface covered). In addition, the SMU sub-dominantly consists of Eluviated Dystric Brunisols that may occur sporadically within the unit on hummocky to undulating reliefs at higher slope positions. Inclusions of imperfectly to poorly drained Gleysolic soils and poorly to very poorly drained Terric Mesisols may also occur within the SMU. Gleysolic soils developed on moderately coarse textured (i.e., loamy sand) glaciofluvial material are generally found in the lower slope positions, swales between undulations, hummocks, or ridges, and in transitions to areas of poor drainage. In contrast, Terric Mesisols composed of organic (i.e., peat) material occur in depressions (i.e., 0% to 0.5% slopes) and low slope areas with very poor drainage.

Mineral-6 (M6)

The M6 SMU covers approximately 69.5 ha (1.5%) of the LSA. The M6 SMU dominantly consists of imperfectly to very poorly drained Orthic Gleysols developed on undulating level to nearly level landscapes (i.e., 0% to 2% slopes). The SMU contains moderately coarse to coarse textured (i.e., loamy sand, sand) glaciofluvial materials that are non-stony to slightly stony (i.e., <0.01% to 0.1% of surface covered). In addition, the SMU sub-dominantly consists of poorly to very poorly drained Terric Mesisols composed of organic (peat) material and occur in depressions (i.e., slopes 0% to 0.5%) and low elevation areas with very poor drainage. Inclusions of Gleyed Eluviated Dystric Brunisols may also occur in transitions to upland areas within the SMU.

Mineral-7 (M7)

The M7 SMU covers approximately 71.8 ha (1.6%) of the LSA. The M7 SMU dominantly consists of rapidly drained to well-drained Eluviated Dystric Brunisols developed on hummocky and low relief ridged landscapes (i.e., >0.5% to 10% slopes). The SMU contains moderately coarse (i.e., loamy sand) glaciofluvial materials that are moderately stony (i.e., 0.1% to 3% of surface covered). In addition, inclusions of Gleyed Eluviated Dystric Brunisols may be found at lower slope to near level positions. Evidence of clay eluviation in the B horizon of the soil profile was observed in 10% to 20% of the Brunisolic soils within the SMU.

Mineral-8 (M8)

The M8 SMU covers approximately 196.1 ha (4.3%) of the LSA. The M8 SMU dominantly consists of rapidly drained Eluviated Dystric Brunisols developed on hummocky and high relief ridged landscapes (i.e., >5 to 45% slopes). The SMU contains moderately coarse (i.e., loamy sand) glaciofluvial materials that are exceedingly stony to excessively stony (i.e., 15% to >50% of surface covered). In addition, inclusions of Gleyed Eluviated Dystric Brunisols may be found at lower slope positions or in transitional areas. Evidence of clay eluviation in the B horizon of the soil profile was observed in 20% to 40% of the Brunisolic soils within the SMU.

Mineral-9 (M9)

The M9 SMU covers approximately 260.6 ha (5.7%) of the LSA. The M9 SMU dominantly consists of well-drained to moderately well-drained Eluviated Dystric Brunisols developed on low relief undulating landscapes (i.e., >0.5% to 10% slopes). The SMU contains moderately coarse to coarse-textured (i.e., loamy sand, sand) glaciofluvial materials that are moderately stony to very stony (i.e., 0.1% to 15% of surface covered). In addition, the SMU sub-dominantly consists of Gleyed Eluviated Dystric Brunisols that occur in lower slope positions within the SMU.

Mineral-10 (M10)

The M10 SMU covers approximately 226.8 ha (5.0%) of the LSA. The M10 SMU dominantly consists of rapidly drained to well-drained Eluviated Dystric Brunisols developed on level to inclined landscapes (i.e., >0.5% to 15% slopes). The SMU contains moderately coarse (i.e., sandy loam) glaciofluvial materials that are very stony (i.e., 3% to 15% of surface covered). In addition, inclusions of Gleyed Eluviated Dystric Brunisols may occur in lower slope positions within the SMU.

Mineral-11 (M11)

The M11 SMU is the smallest SMU and covers approximately 32.3 ha (0.7%) of the LSA. The M11 SMU dominantly consists of moderately well-drained to very poorly drained Gleyed Eluviated Dystric Brunisols developed in association with watercourses and drainage channels (i.e., >0.5% to 5% slopes). The SMU contains moderately coarse to coarse textured (i.e., loamy sand, sand) glaciofluvial materials that are non-stony to very stony (i.e., <0.01% to 15% of surface covered). In addition, the SMU sub-dominantly consists of Eluviated Dystric Brunisols, which generally occur on mid to upper slope positions. Imperfectly drained Gleysolic soils that develop in the lower slope positions, swales between undulations, low positions of hummocks or ridges, and in transitions to areas of poor drainage may also occur within the SMU. In contrast, inclusions of very poorly drained Terric Mesisols composed of organic (i.e., peat) material may occur in depressions (i.e., 0% to 0.5% slopes) and low slope areas.

Mineral-12 (M12)

The M12 SMU is the most abundant SMU in the LSA and covers approximately 893.0 ha (19.6%). The M12 SMU dominantly consists of rapidly drained to moderately well-drained Eluviated Dystric Brunisols developed on undulating and rolling landscapes (i.e., >0.5% to 10% slopes). The SMU contains moderately coarse to coarse textured (i.e., loamy sand, sand, sandy loam) glaciofluvial materials that are slightly stony to moderately stony (i.e., 0.01% to 3% of surface covered). Inclusions of Gleyed Eluviated Dystric Brunisols, and Orthic Gleysols may occur within the SMU in transition areas and in lower slope positions with imperfect to poor drainage.

5.2.1.2 Organic Soil Map Units

The Organic SMUs combined make up approximately 245.7 ha (5.4%) of the LSA. The Organic SMUs differ from each other based on the distribution of dominant wetland (i.e., organic) soils and sub-dominant or inclusion upland or transition (i.e., mineral or mineral peaty phase) soils. The Organic SMUs also differ based on terrain and soil development.

Organic-1 (O1)

The O1 SMU covers approximately 78.5 ha (1.7%) of the LSA. The O1 SMU dominantly consists of very poorly drained Terric Mesisols developed on level to nearly level topography (i.e., 0% to 0.5% slopes), with moderately decomposed organic materials (i.e., fen peat) overlying moderately coarse to coarse textured (loamy sand, sand, sandy loam) glaciofluvial deposits. Inclusions of Gleysols and Gleyed variants of upland mineral soils are generally found in areas of transition to areas with better drainage.

Organic-2 (O2)

The O2 SMU covers approximately 80.2 ha (1.8%) of the LSA. The O2 SMU dominantly consists of very poorly drained Typic Mesisols developed on level to nearly level topography (i.e., 0% to 0.5% slopes), with moderately decomposed organic (i.e., fen peat) materials.

Mesisols are generally found in depressions, low plains and swales between undulations, hummocks, or ridges of bedrock. Inclusions of Terric Mesisols may also occur sporadically within the SMU.

Organic-3 (O3)

The O3 SMU covers approximately 87.0 ha (1.9%) of the LSA. The O3 SMU dominantly consists of very poorly drained Typic Mesisols and sub-dominantly Terric Mesisols that developed on level areas with mineral soil hummocks to nearly level areas (i.e., 0% to 5% slopes), with moderately decomposed organic materials (i.e., fen peat) overlying moderately coarse (i.e., loamy sand) glaciofluvial deposits. Inclusions of Gleysols and Gleyed variants of upland mineral soils such as Gleyed Eluviated Dystric Brunisols may occur within the SMU and are generally found in transition areas and/or moderately well drained areas.

5.2.2 Soil Chemistry and Reclamation Suitability

Analytical chemistry results for soil samples collected in 2018 and 2019 within the maximum disturbance area and LSA are presented in Appendix D. The chemistry results indicated that the pH ranged from 2.86 to 5.20 for all the soil horizons that were analyzed in 2018 and 2019. The B horizon pH values ranged from 3.83 to 4.56 and are considered acidic. The pH for the B horizon is also utilized for the Brunisolic soil classification, greater than 5.5 indicates a Eutric Brunisol and <5.5 is and Dystric Brunisol (SCWG 1987). Dystric Brunisol is the dominant great group within the LSA as seen in Table 11. The pH for the topsoil is the limiting factor for reclamation suitability (Table 12) according to the *Soil Quality Criteria Relative to Disturbance and Reclamation* (Alberta

Agriculture 1982); however, the 2019 reference sites indicate that the acidic pH levels are natural to the area and therefore would not be considered a limiting factor for reclamation success. For the subsoil the pH values ranged from Good to Unsuitable (Table 13).

The electrical conductivity (EC) results for the collected 2018 and 2019 samples ranged from less than 0.10 to 0.29 decisiemens per metre (dS/m), and from 0.15 to 0.35 dS/m, respectively. As EC is a measurement of soil salinity, the results indicate that the representative samples are non-saline. Soils analyzed with EC values less than 1 dS/m are considered to be non-saline soils, where EC values greater than 1 dS/m are considered to be saline soils. The EC values for topsoil and subsoil are Good for reclamation suitability (Table 12, Table 13).

The majority (63%) of the 2018 soil sample horizons analyzed had sodium adsorption ratios (SAR) that were incalculable due to undetectable sodium values and/or calcium and magnesium values that were below the detection limit (i.e., <0.30). The horizons from the 2018 soil sampling that had detectable limits had SAR values ranging from 0.30 to 2.6. The 2019 soil sample horizons analyzed had SAR ranging from 0.1 to 0.7. The reported SAR values represented in Appendix B indicate the maximum detected limit. The actual SAR values may be lower if both calcium and magnesium were detectable for all of the horizons analyzed. The SAR values indicate that the soils within the LSA are non-saline and non-sodic and the topsoil and subsoil (where applicable) are considered Good for reclamation suitability (Table 12, Table 13).

The 2018 CEC values for all samples ranged from less than 0.80 to 7.68 mEq/100g, where the majority (75%) of the horizons from the collected samples from 2018 were below detectable limits. The incalculable or low CEC results indicate that soils in the maximum disturbance area and LSA may have low available nutrients for plants and low buffering capacity against soil acidification. Due to the high percentage (75%) of the sites below detection limits, the CEC results for topsoil and subsoil were not evaluated for reclamation suitability.

The majority (67%) of the 2018 mineral soil sample horizons had coarse-textured (sand to loamy sand), hand texturing from the remaining inspection sites not submitted or sampled in 2018 had comparable coarse-textures (sand, sandy loam, loamy sand) throughout the profiles. The 2019 soil horizons were hand-textured with comparable coarse-textures (sand, sandy loam, loamy sand) throughout the profiles. The topsoil textures were determined to have Poor reclamation suitability with only one site classified as Good for reclamation suitability (Table 12). Subsoil reclamation suitability for texture was classified as Poor with only one site ranging from Poor to Good (Table 13).

Soil chemistry results from the 2018 and 2019 field programs detected leachable metals such as arsenic, barium, cadmium, chromium, copper, lead, nickel, vanadium, and zinc. The complete list of metals detected from the 2018 and 2019 samples is located in Appendix B. Concentrations of leachable metals listed in Appendix B were compared with the lower limits of the *Soil Quality Guidelines for the Protection of Environmental and Human Heath* defined for industrial, agricultural or residential/parkland land uses, whichever is lower (CCME 2014).

Soil concentrations of three metals exceeded the *Soil Quality Guidelines for the Protection of Environmental and Human Heath* defined for agricultural or residential/parkland land uses (CCME 2014). Boron met or exceeded the Soil Quality Guideline for agricultural land use (2 mg/kg dry weight) in all 2019 samples, except for the EXP03 C sample (Table A-4, Appendix B). Boron concentrations were below the Soil Quality Guideline for agriculture land use in all 2018 samples. Sulphur exceeded the Soil Quality Guideline for agriculture land use (500 mg/kg dry weight) at the NR18MS 77 sample location (both soil horizon samples) in 2018 (Table A-4, Appendix B). Uranium exceeded the Soil Quality Guideline for agriculture land use and residential/parkland land use (both 23 mg/kg dry weight) in the 2018 NR18MS 77 sample location of horizon sample. Several (11%) of the metals that were analyzed (e.g., aluminum, iron, strontium, and zirconium) are not listed in the Soil Quality Guidelines (CCME 2014).

Radionuclide analysis of soils samples collected at the 2019 exposure and reference sites identified no detectable levels of lead-210, thorium-228, thorium-230, or thorium-232. Polonium-210 levels ranged between 0.01 and 0.02 becquerels per gram (Bq/g), and radium-226 levels ranged between 0.02 and 0.03 Bq/g (Appendix B). There was a higher concentration of polonium-210 and radium-226 in soils sampled at the reference sites compared to the exposure sites. Compared to the *Canadian Guidelines for the Management of Naturally Occurring Radioactive Materials (NORM)* (Canadian NORM Working Group 2013), none of the radionuclide values that were analyzed in 2019 exceed the derived release limits.

Based on field investigations and laboratory analysis, the mineral SMUs in the maximum disturbance area and LSA are considered to have Poor reclamation suitability ratings in the topsoil (i.e., upper lift) and subsoil (i.e., lower lift). The Poor ratings are due to texture being the primary limiting factor.

Table 12: Topsoil Reclamation Suitability Ratings for the Local Study Area

Site	Reaction (pH)[b]	Salinity (EC) (dS/m)	Sodicity (SAR)	Texture[a]	Limiting Factor[b]
NR18MS 77	Unsuitable	Good	Good	n/a	None
NR18MS 96	Unsuitable	Good	Good	n/a	None
NR18MS 108	Unsuitable	Good	Good	Poor	Texture – Poor
EXP01	Unsuitable	Good	Good	Poor	Texture – Poor
EXP02	Unsuitable	Good	Good	Poor	Texture – Poor
EXP03	Unsuitable	Good	Good	Poor	Texture – Poor
REF04	Unsuitable	Good	Good	Poor	Texture – Poor
REF05	Unsuitable	Good	Good	Good to Poor	Texture – Poor
REF06	Unsuitable	Good	Good	Poor	Texture – Poor

Suitability ratings have been determined for each site, the most limiting factor for each site was displayed when multiple horizons were sampled with different ratings.
a) For sites with mineral and organic horizons sampled, the mineral ratings were used for Texture suitability ratings. For sites where only organic topsoil horizons were sampled no ratings were determined for texture.
b) The pH suitability was not considered when determining limiting factors for the site as the pH ranges identified were within the range of the natural background reference sites.
EC = electrical conductivity; dS/m = decisiemens per metre; n/a = not applicable; SAR = sodium adsorption ratio

Table 13: Subsoil Reclamation Suitability Ratings for the Local Study Area

Site	Reaction (pH)	Salinity (EC) (dS/m)	Sodicity (SAR)	Texture[a]	Limiting Factor[b]
NR18MS 58	Poor to Good	Good	n/a	Poor	Texture & pH – Poor
NR18MS 82	Poor to Fair	Good	Good	Poor	Texture & pH – Poor
NR18MS 96	Unsuitable to Poor	Good	Good	Good to Poor	pH – Unsuitable to Poor Texture - Poor
NR18MS 108	Poor	Good	n/a	Poor	Texture & pH – Poor

Suitability ratings have been determined for each site, the most limiting factor for each site was displayed when multiple horizons were sampled with different ratings.
a) For sites with mineral and organic horizons sampled, the mineral ratings were used for Texture suitability ratings. For sites where only organic topsoil horizons were sampled no ratings were determined for texture.
b) The pH suitability was not considered when determining limiting factors for the site as the pH ranges identified were within the range of the natural background reference sites.
EC = electrical conductivity; dS/m = decisiemens per metre; n/a = not applicable; SAR = sodium adsorption ratio

5.3 Soil Sensitivities

5.3.1 Water and Wind Erosion Sensitivities

5.3.1.1 Water Erosion Sensitivity

Water erosion potentials were assigned to the SMUs within the LSA (Table 14 and Table 15). Water erosion potential for dominant soil subgroups in the majority of the SMUs was Low to Medium, based on the dominantly sandy and loamy sand texture associated with upper mineral soil horizons, gentle slope gradient (<10%), and a dominant slope length greater than 70 m. Soils with Low water erosion potential were associated with smaller slope percentages (Table 14 and Table 15).

In the maximum disturbance area and LSA, the sandy to loamy sand Brunisolic soils at upland landscape positions generally have a Low to Medium sensitivity to water erosion. At transitional and depressional landscape positions, poorly drained Gleysolic soils also have Low to Medium sensitivity to water erosion. In areas with Organic soils that have the shallow organic surface horizons removed and the subsoil materials exposed, the water erosion potential of the underlying material is Low. Deep Organic soils are not rated for water erosion as bare mineral soil will not likely be exposed. Within all SMUs, as slope percentage or slope length increases, the water erosion potential for soils would also increase.

Table 14: Water Erosion Potential Rating for Mineral Soil Map Units within the Local Study Area

Soil Map Unit Name (Map Unit Symbol)	Soil Subgroups in the Soil Map Unit(a)	Dominant Topsoil Horizon Texture	Water Erosion Rating	Dominant Slope Class	Dominant Slope Length (m)	Water Erosion Potential Rating
Mineral-1 (M1)	**Dominantly** Eluviated Dystric Brunisols	Loamy sand	Low	3-6 (>2%-30%)	>70	Low to Medium
Mineral-2 (M2)	**Dominantly** Eluviated Dystric Brunisols	Loamy sand	Low	3-5 (>2%-15%)	>70	Low to Medium
	Inclusions of Gleyed Eluviated Dystric Brunisols					
Mineral-3 (M3)	**Dominantly** Eluviated Dystric Brunisols	Sand	Low	4-7 (>5%-45%)	>70	Low to Medium
	Inclusions of Gleyed Eluviated Dystric Brunisols					
Mineral-4 (M4)	**Dominantly** Eluviated Dystric Brunisols	Sand, loamy sand	Low	1-3 (0%-5%)	>70	Low to Medium
	Sub-dominantly Gleyed Eluviated Dystric Brunisols	Loamy sand, sandy loam	Low to Medium			
	Inclusions of Gleysolic soils	Loamy sand	Low			
Mineral-5 (M5)	**Dominantly** Gleyed Eluviated Dystric Brunisols	Sand, loamy sand	Low	2-3 (>0.5%-5%)	>70	Low
	Sub-dominantly Eluviated Dystric Brunisols					
	Inclusions of Gleysolic soils and Terric Mesisols	Loamy sand / n/a	Low/ n/a			
Mineral-6 (M6)	**Dominantly** Orthic Gleysols	Loamy sand	Low	1-2 (0%-2%)	>70	Low
	Sub-dominantly Terric Mesisols	n/a	n/a			
	Inclusions of Gleyed Eluviated Dystric Brunisols	Sand, loamy sand	Low			

Table 14: Water Erosion Potential Rating for Mineral Soil Map Units within the Local Study Area

Soil Map Unit Name (Map Unit Symbol)	Soil Subgroups in the Soil Map Unit[a]	Dominant Topsoil Horizon Texture	Water Erosion Rating	Dominant Slope Class	Dominant Slope Length (m)	Water Erosion Potential Rating
Mineral-7 (M7)	**Dominantly** Eluviated Dystric Brunisols	Loamy sand	Low	2-4 (>0.5%-10%)	>70	Low
	Inclusions of Gleyed Eluviated Dystric Brunisols					
Mineral-8 (M8)	**Dominantly** Eluviated Dystric Brunisols	Loamy sand	Low	4-7 (>5%-45%)	>70	Low to Medium
	Inclusions of Gleyed Eluviated Dystric Brunisols					
Mineral-9 (M9)	**Dominantly** Eluviated Dystric Brunisols	Sand, loamy sand	Low	2-4 (>0.5%-10%)	>70	Low
	Sub-dominantly Gleyed Eluviated Dystric Brunisols	Loamy sand				
Mineral-10 (M10)	**Dominantly** Eluviated Dystric Brunisols	Sandy loam	Medium	2-5 (>0.5%-15%)	>70	Medium to High
	Inclusions of Gleyed Eluviated Dystric Brunisols					
Mineral-11 (M11)	**Dominantly** Gleyed Eluviated Dystric Brunisols	Sand, loamy sand	Low	2-3 (>0.5%-5%)	>70	Low
	Sub-dominantly Eluviated Dystric Brunisols and Gleysolic soils					
	Inclusions of Terric Mesisols	n/a	n/a			
Mineral-12 (M12)	**Dominantly** Eluviated Dystric Brunisols	Loamy sand, sandy loam	Low to Medium	2-4 (>0.5%-10%)	>70	Low to Medium
	Inclusions of Gleyed Eluviated Dystric Brunisols and Gleysolic soils	Loamy sand	Low			

a) Dominant soil subgroup(s) = cover 60% to 100% of the soil map unit area; co-dominant soil subgroup(s) = cover 40% to 60% of the soil map unit area; sub-dominant soil subgroup(s) = cover 20% to 40% of the soil map unit area; inclusion = cover 15% to 20% of the soil map unit area. The LSA includes the maximum disturbance area and is based on a 1 km buffer around the maximum disturbance area.
< = less than; n/a = not applicable; LSA = local study area.

Table 15: Water Erosion Potential Rating for Organic Soil Map Units within Local Study Area

Soil Map Unit Name (Map Unit Symbol)	Soil Subgroups in Soil Map Unit[a]	Dominant Topsoil Horizon Texture	Water Erosion Rating	Dominant Slope Class	Dominant Slope Length (m)	Water Erosion Potential Rating
Organic-1 (O1)	**Dominantly** Terric Mesisols	n/a	n/a	1 (0%-0.5%)	<70	n/a
	Inclusions of Gleysolic soils	Sand, loamy sand	Low			Low
Organic-2 (O2)	**Dominantly** Typic Mesisols	n/a	n/a	1 (0%-0.5%)	<70	n/a
	Inclusions of Terric Mesisols	n/a	n/a			
Organic-3 (O3)	**Dominantly** Typic Mesisols	n/a	n/a	1 (0%-0.5%)	<70	n/a
	Inclusions of Gleysolic soils and Gleyed Eluviated Dystric Brunisols	Loamy sand	Low			Low

a) Dominant soil subgroup(s) = cover 60% to 100% of the soil map unit area; co-dominant soil subgroup(s) = cover 40% to 60% of the soil map unit area; sub-dominant soil subgroup(s) = cover 20% to 40% of the soil map unit area; inclusion = cover 15% to 20% of the soil map unit area. The LSA includes the maximum disturbance area and is based on a 1 km buffer around the maximum disturbance area.

< = less than; n/a = not applicable; LSA = local study area.

5.3.1.2 Wind Erosion Sensitivity

Wind erosion ratings were assigned to SMUs within the maximum disturbance area and LSA (Table 16 and Table 17). Wind erosion ratings of mineral soils are based on disturbed, bare soils, and wind erosion ratings of Organic soils are based on degree of peat decomposition under dry and disturbed conditions.

Wind erosion ratings for dominant soil subgroups in the majority of the SMUs was High, based on the sandy and loamy sand textured mineral upper soil horizons. Soils with Moderate wind erosion ratings were associated with sandy loam textured mineral upper soil horizons. Organic horizons were identified to have Low wind erosion ratings due to decomposition of the uppermost organic horizon (Table 17).

Soils most sensitive to wind erosion include sandy and loamy sand textured Brunisolic soils. In the event Organic surface materials are removed and underlying mineral soil horizons are exposed, the wind erosion ratings remain High due to the sandy textures. Areas containing Organic Mesisols and peaty phase Gleysolic soils with silt or silt loam topsoil mineral horizons have a Low sensitivity to wind erosion.

Table 16: Wind Erosion Potential Rating for Mineral Soil Map Units within the Maximum Disturbance Area and Local Study Area

Soil Map Unit Name (Map Unit Symbol)	Soil Subgroups in the Soil Map Unit[(a)]	Dominant Topsoil Horizon Texture	Wind Erosion Potential Rating
Mineral-1 (M1)	**Dominantly** Eluviated Dystric Brunisols	Loamy sand	High
Mineral-2 (M2)	**Dominantly** Eluviated Dystric Brunisols	Loamy sand	High
	Inclusions of Gleyed Eluviated Dystric Brunisols		
Mineral-3 (M3)	**Dominantly** Eluviated Dystric Brunisols	Sand	High
	Inclusions of Gleyed Eluviated Dystric Brunisols		
Mineral-4 (M4)	**Dominantly** Eluviated Dystric Brunisols	Sand, loamy sand	High
	Sub-dominantly Gleyed Eluviated Dystric Brunisols	Loamy sand, sandy loam	Moderate to High
	Inclusions of Gleysolic soils	Loamy sand	High
Mineral-5 (M5)	**Dominantly** Gleyed Eluviated Dystric Brunisols	Sand, loamy sand	High
	Sub-dominantly Eluviated Dystric Brunisols		
	Inclusions of Gleysolic soils and Terric Mesisols	Loamy sand / n/a	High/Low
Mineral-6 (M6)	**Dominantly** Orthic Gleysols	Loamy sand	High
	Sub-dominantly Terric Mesisols	n/a	Low
	Inclusions of Gleyed Eluviated Dystric Brunisols	Sand, loamy sand	High
Mineral-7 (M7)	**Dominantly** Eluviated Dystric Brunisols	Loamy sand	High
	Inclusions of Gleyed Eluviated Dystric Brunisols		

Table 16: Wind Erosion Potential Rating for Mineral Soil Map Units within the Maximum Disturbance Area and Local Study Area

Soil Map Unit Name (Map Unit Symbol)	Soil Subgroups in the Soil Map Unit[(a)]	Dominant Topsoil Horizon Texture	Wind Erosion Potential Rating
Mineral-8 (M8)	**Dominantly** Eluviated Dystric Brunisols	Loamy sand	High
	Inclusions of Gleyed Eluviated Dystric Brunisols		
Mineral-9 (M9)	**Dominantly** Eluviated Dystric Brunisols	Sand, loamy sand	High
	Sub-dominantly Gleyed Eluviated Dystric Brunisols	Loamy sand	
Mineral-10 (M10)	**Dominantly** Eluviated Dystric Brunisols	Sandy loam	Moderate
	Inclusions of Gleyed Eluviated Dystric Brunisols		
Mineral-11 (M11)	**Dominantly** Gleyed Eluviated Dystric Brunisols	Sand, loamy sand	High
	Sub-dominantly Eluviated Dystric Brunisols and Gleysolic soils		
	Inclusions of Terric Mesisols	n/a	Low
Mineral-12 (M12)	**Dominantly** Eluviated Dystric Brunisols	Loamy sand, sandy loam	Moderate to High
	Inclusions of Gleyed Eluviated Dystric Brunisols and Gleysolic soils	Loamy sand	High

a) Dominant soil subgroup(s) = cover 60% to 100% of the soil map unit area; co-dominant soil subgroup(s) = cover 40% to 60% of the soil map unit area; sub-dominant soil subgroup(s) = cover 20% to 40% of the soil map unit area; inclusion = cover 15% to 20% of the soil map unit area. The LSA includes the maximum disturbance area and is based on a 1 km buffer around the maximum disturbance area.
n/a = not applicable; LSA = local study area.

Table 17: Wind Erosion Potential Rating for Organic Soil Map Units within the Maximum Disturbance Area and Local Study Area

Soil Map Unit Name (Map Unit Symbol)	Soil Subgroups in Soil Map Unit[(a)]	Dominant Topsoil Horizon Texture	Wind Erosion Potential Rating
Organic-1 (O1)	**Dominantly** Terric Mesisols	n/a	Low
	Inclusions of Gleysolic soils	Sand, loamy sand	High
Organic-2 (O2)	**Dominantly** Typic Mesisols	n/a	Low
	Inclusions of Terric Mesisols	n/a	Low
Organic-3 (O3)	**Dominantly** Typic Mesisols	n/a	Low
	Inclusions of Gleysolic soils and Gleyed Eluviated Dystric Brunisols	Loamy sand	High

a) Dominant soil subgroup(s) = cover 60% to 100% of the soil map unit area; co-dominant soil subgroup(s) = cover 40% to 60% of the soil map unit area; sub-dominant soil subgroup(s) = cover 20% to 40% of the soil map unit area; inclusion = cover 15% to 20% of the soil map unit area. The LSA includes the maximum disturbance area and is based on a 1 km buffer around the maximum disturbance area.
n/a = not applicable; LSA = local study area.

5.3.2 Sensitivity to Acidification

Acidification sensitivity ratings were assigned to the SMUs within the maximum disturbance area and LSA Table 18 and Table 19). Brunisolic soils had a sand or loamy sand topsoil texture, and these textures are generally associated with a low CEC. Brunisolic B horizon pH values ranged from 3.83 to 4.56 from the soil samples collected; therefore, topsoil horizons would also be considered as acidic. As all soil samples from Brunisols in the maximum disturbance area and LSA had a pH less than 5.5, all Brunisolic soils in the maximum disturbance area and LSA have been assumed to have a pH less than 5.5. Due to the low CEC and low pH values in the samples, these Brunisolic soils have a High sensitivity to acidification.

Organic soils within all SMUs have Low to Moderate sensitivity to acidification depending on the associated wetland type. Moderate, rich, and extreme rich fens have a Low sensitivity to acidification. Bogs and poor fens are rated as having a Moderate sensitivity to acidification.

Gleysolic soils generally had sandy loam textures, which are associated with low to high CEC (Table 18). These soils occur in transitional areas adjacent to wetlands; therefore, the pH values would be influenced by water associated with the adjacent wetland type. Even in areas that are considered to be in the peaty phase, the overlying shallow organic layer would be influenced by underlying materials. In general, these soils are considered to have a Low to Moderate sensitivity to acidification; this rating would increase to Moderate to High where soils occur adjacent to acidic bogs or where textures are sandy.

Overall, in the maximum disturbance area and LSA, upland landscape positions containing well-drained, sandy-textured soils are most sensitive to acidification, whereas wetlands containing Organic soils (i.e., within bogs, fens, and swamps) have a Low to Moderate sensitivity to acidification (Table 19). Gleysolic soils generally have a Low to Moderate sensitivity; the exception occurs when these soils have sandy textures and are subsequently rated as a High sensitivity to acidification.

Table 18: Acidification Potential Rating for Mineral Soil Map Units within the Maximum Disturbance Area and Local Study Area

Soil Map Unit Name (Map Unit Symbol)	Soil Subgroups in the Soil Map Unit[a]	Dominant Topsoil Horizon Texture	Expected Range of CEC (mEq/100 g) Based on Soil Texture[b]	Acidification Sensitivity Potential Rating
Mineral-1 (M1)	**Dominantly** Eluviated Dystric Brunisols	Loamy sand	<6	High
Mineral-2 (M2)	**Dominantly** Eluviated Dystric Brunisols	Loamy sand	<6	High
	Inclusions of Gleyed Eluviated Dystric Brunisols			
Mineral-3 (M3)	**Dominantly** Eluviated Dystric Brunisols	Sand	<6	High
	Inclusions of Gleyed Eluviated Dystric Brunisols			
Mineral-4 (M4)	**Dominantly** Eluviated Dystric Brunisols	Sand, loamy sand	<6	Moderate to High
	Sub-dominantly Gleyed Eluviated Dystric Brunisols	Loamy sand, sandy loam	<6-15	
	Inclusions of Gleysolic soils	Loamy sand	<6	

Table 18: Acidification Potential Rating for Mineral Soil Map Units within the Maximum Disturbance Area and Local Study Area

Soil Map Unit Name (Map Unit Symbol)	Soil Subgroups in the Soil Map Unit[a]	Dominant Topsoil Horizon Texture	Expected Range of CEC (mEq/100 g) Based on Soil Texture[b]	Acidification Sensitivity Potential Rating
Mineral-5 (M5)	**Dominantly** Gleyed Eluviated Dystric Brunisols	Sand, loamy sand	<6	Moderate to High
	Sub-dominantly Eluviated Dystric Brunisols			
	Inclusions of Gleysolic soils and Terric Mesisols	Loamy sand / n/a	<6 / n/a	
Mineral-6 (M6)	**Dominantly** Orthic Gleysols	Loamy sand	<6	Moderate to High
	Sub-dominantly Terric Mesisols	n/a	n/a	
	Inclusions of Gleyed Eluviated Dystric Brunisols	Sand, loamy sand	<6	
Mineral-7 (M7)	**Dominantly** Eluviated Dystric Brunisols	Loamy sand	<6	High
	Inclusions of Gleyed Eluviated Dystric Brunisols			
Mineral-8 (M8)	**Dominantly** Eluviated Dystric Brunisols	Loamy sand	<6	High
	Inclusions of Gleyed Eluviated Dystric Brunisols			
Mineral-9 (M9)	**Dominantly** Eluviated Dystric Brunisols	Sand, loamy sand	<6	High
	Sub-dominantly Gleyed Eluviated Dystric Brunisols	Loamy sand		
Mineral-10 (M10)	**Dominantly** Eluviated Dystric Brunisols	Sandy loam	6-15	Moderate to High
	Inclusions of Gleyed Eluviated Dystric Brunisols			
Mineral-11 (M11)	**Dominantly** Gleyed Eluviated Dystric Brunisols	Sand, loamy sand	<6	Moderate to High
	Sub-dominantly Eluviated Dystric Brunisols and Gleysolic soils			
	Inclusions of Terric Mesisols	n/a	n/a	
Mineral-12 (M12)	**Dominantly** Eluviated Dystric Brunisols	Loamy sand, sandy loam	<6-15	Moderate to High
	Inclusions of Gleyed Eluviated Dystric Brunisols and Gleysolic soils			

a) Dominant soil subgroup(s) = cover 60% to 100% of the soil map unit area; co-dominant soil subgroup(s) = cover 40% to 60% of the soil map unit area; sub-dominant soil subgroup(s) = cover 20% to 40% of the soil map unit area; inclusion = cover 15% to 20% of the soil map unit area. The LSA includes the maximum disturbance area and is based on a 1 km buffer around the maximum disturbance area.

n/a = not applicable; LSA = local study area.

Table 19: Acidification Rating for Organic Soil Map Units Within the Maximum Disturbance Area and Local Study Area

Soil Map Unit Name (Map Unit Symbol)	Soil Subgroups in the Soil Map Unit[a]	Dominant Topsoil Horizon Texture	Expected Range of CEC (mEq/100 g) Based on Soil Texture[b]	Acidification Sensitivity Potential Rating
Organic-1 (O1)	**Dominantly** Terric Mesisols	n/a	n/a	Low to Moderate
	Inclusions of Gleysolic soils	Sand, loamy sand	<6	High
Organic-2 (O2)	**Dominantly** Typic Mesisols	n/a	n/a	Low to Moderate
	Inclusions of Terric Mesisols	n/a	n/a	Low to Moderate
Organic-3 (O3)	**Dominantly** Typic Mesisols	n/a	n/a	Low to Moderate
	Inclusions of Gleysolic soils and Gleyed Eluviated Dystric Brunisols	Loamy sand	<6	High

a) Dominant soil subgroup(s) = cover 60% to 100% of the soil map unit area; co-dominant soil subgroup(s) = cover 40% to 60% of the soil map unit area; sub-dominant soil subgroup(s) = cover 20% to 40% of the soil map unit area; inclusion = cover 15% to 20% of the soil map unit area. The LSA includes the maximum disturbance area and is based on a 1 km buffer around the maximum disturbance area.
b) Derived from soil data presented in Holowaychuk and Fessenden (1987).
< = less than; > = greater than; n/a = not applicable; CEC = cation exchange capacity; LSA = local study area.

5.3.3 Permafrost Potential

The maximum disturbance area and LSA are within the sporadic scattered discontinuous permafrost zone where permafrost may occupy approximately 10% to 50% of the area (Natural Resources Canada 1995). The distribution and occurrence of permafrost is highly variable in the scattered discontinuous permafrost zone. The permafrost in this area is characterized by having low ice content, indicating the ground ice content in the upper 10 to 20 m of the ground has less than 10% ice content by volume of visible ice (Natural Resources Canada 1995). Though most treed bogs have a higher potential to contain permafrost, many fens are free of permafrost (Zoltai 1995). Within the maximum disturbance area and LSA, permafrost, if present, likely occurs in treed bogs with poorly drained Organic soils. No observations of permafrost were recorded during the 2018 and 2019 soil surveys.

In general, imperfectly to poorly drained soils have Low to Moderate permafrost potential, whereas moderately to rapidly drained soils have Very Low potential for permafrost (Table 20). Sandy textured Brunisolic soils in the maximum disturbance area and LSA have Very Low permafrost potential. Gleysolic soils and soils with poor to moderately well drainage have Low permafrost potential. Overall, Organic soils have Low to Moderate potential to contain permafrost (Table 21).

Table 20: Permafrost Potential Rating for Soil Map Units within the Local Study Area

Soil Map Unit Name (Map Unit Symbol)	Soil Subgroups in the Soil Map Unit[a]	Dominant Topsoil Horizon Texture	Soil Drainage Class	Permafrost Potential Rating
Mineral-1 (M1)	**Dominantly** Eluviated Dystric Brunisols	Loamy sand	Rapid to Well	Very Low
Mineral-2 (M2)	**Dominantly** Eluviated Dystric Brunisols	Loamy sand	Rapid to Moderately Well	Very Low
	Inclusions of Gleyed Eluviated Dystric Brunisols			
Mineral-3 (M3)	**Dominantly** Eluviated Dystric Brunisols	Sand	Rapid	Very Low
	Inclusions of Gleyed Eluviated Dystric Brunisols			

Table 20: Permafrost Potential Rating for Soil Map Units within the Local Study Area

Soil Map Unit Name (Map Unit Symbol)	Soil Subgroups in the Soil Map Unit[a]	Dominant Topsoil Horizon Texture	Soil Drainage Class	Permafrost Potential Rating
Mineral-4 (M4)	**Dominantly** Eluviated Dystric Brunisols	Sand, loamy sand	Well to Imperfect	Low
	Sub-dominantly Gleyed Eluviated Dystric Brunisols	Loamy sand, sandy loam		
	Inclusions of Gleysolic soils	Loamy sand		
Mineral-5 (M5)	**Dominantly** Gleyed Eluviated Dystric Brunisols	Sand, loamy sand	Moderately Well	Low
	Sub-dominantly Eluviated Dystric Brunisols			
	Inclusions of Gleysolic soils and Terric Mesisols	Loamy sand / n/a		
Mineral-6 (M6)	**Dominantly** Orthic Gleysols	Loamy sand	Imperfect to Very Poor	Low to Moderate
	Sub-dominantly Terric Mesisols	n/a		
	Inclusions of Gleyed Eluviated Dystric Brunisols	Sand, loamy sand		
Mineral-7 (M7)	**Dominantly** Eluviated Dystric Brunisols	Loamy sand	Rapid to Well	Very Low
	Inclusions of Gleyed Eluviated Dystric Brunisols			
Mineral-8 (M8)	**Dominantly** Eluviated Dystric Brunisols	Loamy sand	Rapid	Very Low
	Inclusions of Gleyed Eluviated Dystric Brunisols			
Mineral-9 (M9)	**Dominantly** Eluviated Dystric Brunisols	Sand, loamy sand	Well to Moderately Well	Low
	Sub-dominantly Gleyed Eluviated Dystric Brunisols	Loamy sand		
Mineral-10 (M10)	**Dominantly** Eluviated Dystric Brunisols	Sandy loam	Rapid to Well	Very Low
	Inclusions of Gleyed Eluviated Dystric Brunisols			
Mineral-11 (M11)	**Dominantly** Gleyed Eluviated Dystric Brunisols	Sand, loamy sand	Moderately Well to Very Poor	Low to Moderate
	Sub-dominantly Eluviated Dystric Brunisols and Gleysolic soils			
	Inclusions of Terric Mesisols	n/a		
Mineral-12 (M12)	**Dominantly** Eluviated Dystric Brunisols	Loamy sand, sandy loam	Rapid to Moderately Well	Low to Moderate
	Inclusions of Gleyed Eluviated Dystric Brunisols and Gleysolic soils			

a) Dominant soil subgroup(s) = cover 60% to 100% of the soil map unit area; co-dominant soil subgroup(s) = near equal proportion of the soil map unit area covered; sub-dominant soil subgroup(s) = cover 15% to 40% of the soil map unit area. The LSA includes the maximum disturbance area and is based on a 1 km buffer around the maximum disturbance area.

n/a = not applicable; LSA = local study area.

Table 21: Permafrost Potential Rating for Organic Soil Map Units within the Local Study Area

Soil Map Unit Name (Map Unit Symbol)	Soil Subgroups in the Soil Map Unit[(a)]	Dominant Topsoil Horizon Texture	Soil Drainage Class	Permafrost Potential
Organic-1 (O1)	**Dominantly** Terric Mesisols	n/a	Very Poor	Low to Moderate
	Inclusions of Gleysolic soils	Sand, loamy sand		
Organic-2 (O2)	**Dominantly** Typic Mesisols	n/a	Very Poor	Low to Moderate
	Inclusions of Terric Mesisols	n/a		
Organic-3 (O3)	**Dominantly** Typic Mesisols	n/a	Imperfect to Very Poor	Low to Moderate
	Inclusions of Gleysolic soils and Gleyed Eluviated Dystric Brunisols	Loamy sand		

a) Dominant soil subgroup(s) = cover 60% to 100% of the soil map unit area; co-dominant soil subgroup(s) = near equal proportion of the soil map unit area covered; sub-dominant soil subgroup(s) = cover 15% to 40% of the soil map unit area. The LSA includes the maximum disturbance area and is based on a 1 km buffer around the maximum disturbance area.

n/a = not applicable; LSA = local study area.

5.3.4 Sensitivity to Compaction

Compaction ratings for SMUs in the LSA are listed in Table 22 and Table 23. Sandy and loamy sand textured Brunisols have a Low sensitivity to compaction under moist soil conditions. Gleysolic soils, including peaty phase Gleysolic soils, generally had sandy, sandy loam, silt, and silt loam textures in the upper and lower mineral soil horizons, indicating Moderate to Very High sensitivity to compaction under wet soil conditions.

Table 22: Compaction Potential Ratings for Mineral Soil Map Units within the Local Study Area

Soil Map Unit Name (Map Unit Symbol)	Soil Subgroups in the Soil Map Unit[(a)]	Dominant Topsoil Horizon Texture	Mineral Soil Compaction Rating
Mineral-1 (M1)	**Dominantly** Eluviated Dystric Brunisols	Loamy sand	Low
Mineral-2 (M2)	**Dominantly** Eluviated Dystric Brunisols	Loamy sand	Low
	Inclusions of Gleyed Eluviated Dystric Brunisols		
Mineral-3 (M3)	**Dominantly** Eluviated Dystric Brunisols	Sand	Low
	Inclusions of Gleyed Eluviated Dystric Brunisols		
Mineral-4 (M4)	**Dominantly** Eluviated Dystric Brunisols	Sand, loamy sand	Low
	Sub-dominantly Gleyed Eluviated Dystric Brunisols	Loamy sand, sandy loam	
	Inclusions of Gleysolic soils	Loamy sand	
Mineral-5 (M5)	**Dominantly** Gleyed Eluviated Dystric Brunisols	Sand, loamy sand	Low to Moderate
	Sub-dominantly Eluviated Dystric Brunisols		
	Inclusions of Gleysolic soils and Terric Mesisols	Loamy sand / n/a	Low / n/a
Mineral-6 (M6)	**Dominantly** Orthic Gleysols	Loamy sand	Moderate to High
	Sub-dominantly Terric Mesisols	n/a	n/a
	Inclusions of Gleyed Eluviated Dystric Brunisols	Sand, loamy sand	Low
Mineral-7 (M7)	**Dominantly** Eluviated Dystric Brunisols	Loamy sand	Low
	Inclusions of Gleyed Eluviated Dystric Brunisols		

Table 22: Compaction Potential Ratings for Mineral Soil Map Units within the Local Study Area

Soil Map Unit Name (Map Unit Symbol)	Soil Subgroups in the Soil Map Unit[a]	Dominant Topsoil Horizon Texture	Mineral Soil Compaction Rating
Mineral-8 (M8)	**Dominantly** Eluviated Dystric Brunisols	Loamy sand	Low
	Inclusions of Gleyed Eluviated Dystric Brunisols		
Mineral-9 (M9)	**Dominantly** Eluviated Dystric Brunisols	Sand, loamy sand	Low
	Sub-dominantly Gleyed Eluviated Dystric Brunisols	Loamy sand	
Mineral-10 (M10)	**Dominantly** Eluviated Dystric Brunisols	Sandy loam	Moderate
	Inclusions of Gleyed Eluviated Dystric Brunisols		
Mineral-11 (M11)	**Dominantly** Gleyed Eluviated Dystric Brunisols	Sand, loamy sand	Low to Moderate
	Sub-dominantly Eluviated Dystric Brunisols and Gleysolic soils		
	Inclusions of Terric Mesisols	n/a	n/a
Mineral-12 (M12)	**Dominantly** Eluviated Dystric Brunisols	Loamy sand, sandy loam	Low
	Inclusions of Gleyed Eluviated Dystric Brunisols and Gleysolic soils		

a) Dominant soil subgroup(s) = cover 60% to 100% of the soil map unit area; co-dominant soil subgroup(s) = near equal proportion of the soil map unit area covered; sub-dominant soil subgroup(s) = cover 15% to 40% of the soil map unit area. The LSA includes the maximum disturbance area and is based on a 1 km buffer around the maximum disturbance area.

n/a = not applicable; LSA = local study area.

Table 23: Compaction Potential Rating for Organic Soil Map Units within the Local Study Area

Soil Map Unit Name (Map Unit Symbol)	Soil Subgroups in Map Unit[a]	Dominant Mineral Soil Texture	Mineral Soil Compaction Rating
Organic-1 (O1)	**Dominantly** Terric Mesisols	n/a	n/a
	Inclusions of Gleysolic soils	Sand, loamy sand	Low
Organic-2 (O2)	**Dominantly** Typic Mesisols	n/a	n/a
	Inclusions of Terric Mesisols	n/a	n/a
Organic-3 (O3)	**Dominantly** Typic Mesisols	n/a	n/a
	Inclusions of Gleysolic soils and Gleyed Eluviated Dystric Brunisols	Loamy sand	Low

a) Dominant soil subgroup(s) = cover 60% to 100% of the soil map unit area; co-dominant soil subgroup(s) = near equal proportion of the soil map unit area covered; sub-dominant soil subgroup(s) = cover 15% to 40% of the soil map unit area. The LSA includes the maximum disturbance area and is based on a 1 km buffer around the maximum disturbance area.

n/a = not applicable; LSA = local study area.

6.0 SUMMARY

The 2018 and 2019 field program results indicate the terrain in most (65%) of the maximum disturbance area and local study area (LSA) comprises undulating to hummocky upland landscape with high relief and dominant surface stoniness class of Very Stony (3% to 15% of ground surface covered). Soil inspections during the field programs indicate that the maximum disturbance area and LSA predominantly consists of loamy sand textured soils formed from glaciofluvial parent material and outwash depositional settings.

The maximum disturbance area and LSA was predominantly classified within the Brunisolic order, with some instances of Gleysolic and Organic orders. The Brunisolic order included subgroup classifications of Eluviated Dystric Brunisol and Gleyed Eluviated Dystric Brunisol. The great group classification (i.e., Eutric and Dystric) was confirmed using the B horizon pH. The soil inspection site within the Gleysolic order was classified as an Orthic Gleysol. Soils classified within the Organic order included Mesic Fibrisol, Fibric Mesisol, Terric Mesisol, and Terric Humisol.

Soil chemistry results from the 2018 and 2019 field programs indicate that concentrations of all metals that were analyzed did not exceed the upper limits of the listed metals in the *Soil Quality Guidelines for the Protection of Environmental and Human Heath* (CCME 2014). Radionuclide analysis of soils samples collected at the 2019 exposure and reference sites identified no detectable levels of lead-210, thorium-228, thorium-230, and thorium-232. Polonium-210 levels ranged between 0.01 and 0.02 becquerels per gram (Bq/g), and radium-226 levels ranged between 0.02 and 0.03 Bq/g. There was a higher concentration of polonium-210 and radium-226 in soils sampled at the reference sites compared to the exposure sites. When compared to the *Canadian Guidelines for the Management of Naturally Occurring Radioactive Materials* (Canadian NORM Working Group 2013), none of the radionuclide values that were analyzed in 2019 exceed the upper limits.

Reclamation suitability of the upper lift mineral soils is rated as Poor due to the general soil profile texture of each mineral soil map unit (SMU) within the maximum disturbance area and LSA. The upper and lower lift ratings for the Organic SMUs within the maximum disturbance area and LSA were deemed not applicable for reclamation purposes, except for mineral soil inclusions that are considered to have a Poor reclamation suitability.

Wind erosion ratings for dominant mineral soil subgroups in all SMUs were generally High in the maximum disturbance area and LSA, based on either sandy-textured mineral upper soil horizons or disturbed upper soil horizons. Sandy Brunisolic soils were deemed to be most sensitive to wind erosion. Surface horizons of Organic soils were deemed to have Low wind erosion ratings. In the event Organic soils are removed and underlying mineral soil horizons are exposed, the wind erosion ratings would be deemed to be High because of the sandy textures contained within the underlying material.

Overall, the uplands in the maximum disturbance area and LSA contain moderately well to rapidly drained sandy soils and are predicted to be most sensitive to acidification (i.e., High sensitivity). Wetlands containing Organic soils (i.e., within bogs, fens, and swamps) have a Low to Moderate sensitivity to acidification.

Brunisolic soils within the maximum disturbance area and LSA generally have Very Low permafrost potential rating. Gleysolic soils and soils with poor to moderately well drainage have Low permafrost potential. Areas of treed bogs containing Organic soils would be the most likely to contain permafrost; however, no permafrost soils were observed during the field programs. Overall, Organic soils have Low to Moderate potential to contain permafrost where permafrost potential within the maximum disturbance area and LSA is Low.

Sandy and loamy sand textured Brunisols have a Low sensitivity to compaction under moist soil conditions. Gleysolic soils with sandy and sandy loam textures in the upper and lower mineral soil horizons also generally have a Low sensitivity to compaction under moist conditions. Overall, compaction sensitivity in the maximum disturbance area and LSA is Low.

The objectives of the terrain and baseline study, to obtain information on terrain and sensitive terrain, characterize existing soil quality and distribution and determine baseline soil chemistry and evaluate soil sensitivities within the maximum disturbance area and LSA, have been met.

CLOSING

Golder is pleased to submit this report to NexGen in support of the environmental assessment for the Rook I Project. For details on the limitations and use of information presented in this report, please refer to the Study Limitations section following this page. If you have any questions or require additional details related to this study, please contact the undersigned.

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APPENDIX A

Joint Working Group Feedback Applicable to Terrain and Soils Baseline

Table A-1 presents the comments and feedback NexGen has received from members of local Indigenous communities through established Joint Working Group meetings. NexGen continues to engage with communities, and the feedback presented in Table A-1 reflects comments and feedback received through March 2020 that were related to baseline terrain and soils or the comprehensive baseline program generally.

Table A-1: Joint Working Group Feedback – Terrain and Soils

Community	Comment
Birch Narrows Dene Nation (BNDN)	Are you aware of any huge adverse environmental impacts in any of the current mine sites?
	Important topics for the Joint Working Group moving forward are Indigenous knowledge, traditional land use, the species discussion, water quality, environmental monitoring, employment and business opportunities.
	Could we ask that you take samples here? That way we can see changes into the future. Even if it isn't affected by the mine. Respectfully, I request that samples are taken here.
	What's the elevation on the shore?
Buffalo River Dene Nation (BRDN)	Have you gone to communities to show what you are doing? If so, what was the feedback?
	It's important to explain the Project to elders in a way that they can then explain it to other elders in the communities.
	I met an old guy in Lac Brochet; I was standing there and he came up to me. Lac Brochet is landscaped by rocks. He's from Brochet and he goes back and forth to Lac Brochet. He said, see that rock there? I said yes. It's alive, he said. There's one spot on the lake where everyone stops to have tea. One trip a few years ago he stopped at that island and started a fire to make tea. He heard rumbling; it was a clear sky. He thought it was maybe jets flying over, but it got louder and he could feel the ground shaking. He could see the water rippling where the boat launch was. Suddenly he saw the top of a rock come out through the top of the lake. He got scared. He left and went to Lac Brochet. On the way home he didn't want to stop there but he went around the island looking, and that rock was up on the shore. He said it crawled right up there. That's why he said those rocks are alive. That story is from not even 30 years ago.
Clearwater River Dene Nation (CRDN)	Remember, we're trying to implement a plain speak document because of visual concepts of understanding. That is what the Chief is talking about.
	In terms of baseline studies, are there any opportunities for community involvement with any of your residual baseline work, from fish, terrestrial, etc.?
	We will eventually throw in our environmental monitors. I don't know if you knew that. We want to train our own people because of lack of trust of government and industry.
	The interim CRDN Rights and Knowledge study will come out of the CRDN-defined initial list of valued components that we want to talk to you about. As we go through there may be additional ones. We know there's a certain window, but we'll try to be as comprehensive as possible. It may not be as linear as moose; it might be having undisturbed places on waterbodies. They might be more complex.
	How far away from the mine to the lake?
	Not on the old or existing mines that are sitting there?
	Golder does the same thing – hires three or four band members to do the interviews, then takes the notes and puts the document together. When you find the stuff it's not always based on the relationship to the stuff. It's based on what the government's qualifications are on the Environmental Assessment's impacts, and not the actual concerns of it. I'm trying to reach what [CRDN member] is saying between traditional and modern ways.

Table A-1: Joint Working Group Feedback – Terrain and Soils

Community	Comment
Clearwater River Dene Nation (CRDN)	When we started looking at the strategy process, there is that interpretation of cumulative effects. Then we define and introduce an interpretation for that. It's not just one side, western science, we're doing the traditional side as well. That's what the Chief's referring to.
	Both traditional and western science are very important.
	Will we see the results of those studies?
	How many other projects are in that square box (referring to map)?
	Do other companies have mineral holdings in that box on the map – like for oil and gas?
	I think it's really important to compare Cluff Lake to what's happening in the baseline studies. It's a good question.
	What's the purpose of trying to gather all this information?
Métis Nation – Saskatchewan (MN-S)	We have to understand all living and non-living things.
	Are any community members involved in the establishment of the baseline for environmental monitoring, so can they verify their accuracy? Would the results be released and reviewed by the community? From a trust point of view, our people will want to know that those numbers are accurate now, not later. Just a comment to think about.
	How would this group know – is there a way for the people involved in the studies to inform the group of what they saw and if they are confident, they are accurate? Once the stuff hits the Environmental Impact Statement (EIS), how do we know that it is good? If community folks that were involved in that process and they can validate the results, that brings comfort to community members.
	How often are you monitoring?
	It's that validation we're looking for. When I had to involve community members in monitoring, I would get them to write a report if they couldn't speak to the broader community in general. If they didn't feel like writing it, they could talk so someone who would transcribe it. That report could give a summary of how things went, what they saw, were the readings accurate; that could come back to this group, if they couldn't present themselves. The point [MN-S member's] trying to make is, we need some connection to that community resource that's out there doing the monitoring and seeing this stuff. We know who they are, and we're confident in the results. That builds trust.
	Do you have instruments or people taking samples? What does an instrument look like?
	The studies we did a few years back, these guys don't want to use them. That's what I heard.
	I had feedback on community engagement, and I'm trying to figure out how we can move forward in a responsible way where people have their input without being offended. We're working towards a bigger goal than what is currently perceived. We need a discussion on how we can approach it. I can offer some high-level thinking to help bring my community around.
	We should have more of these meetings with other companies like this. I'd like to get a Métis community member to work side by side with you guys and report the environmental side to the community instead of you guys doing it, so we know where we are and how much damage is being done to the land.
	This is general – the same information will come back to all the Joint Working Groups??

BNDN = Birch Narrows Dene Nation; BRDN = Buffalo River Dene Nation; CRDN = Clearwater River Dene Nation; EIS = Environmental Impact Statement; MNS = Métis Nation – Saskatchewan.

APPENDIX B

Chemical Analysis Results

Table B-1: Soil pH Results

Sampling Program	Sample	Horizon	Depth	pH
			cm	1:2 $CaCl_2$
2018 soil survey baseline	NR18MS 58	AC	0-13	4.13
	NR18MS 58	Bm	13-34	4.56
	NR18MS 58	Cg	34-100	5.20
	NR18MS 77	Of	0-40	3.41
	NR18MS 77	Om	40-95	3.17
	NR18MS 82	AC	0-7	4.09
	NR18MS 82	Bj	7-35	4.54
	NR18MS 96	LFH	9-0	2.86
	NR18MS 96	AhC	0-5	3.20
	NR18MS 96	Bmgj	5-24	4.24
	NR18MS 96	BC	24-55	3.91
	NR18MS 96	C	55-100	4.33
	NR18MS 108	LFH	4-0	3.22
	NR18MS 108	Aegj	0-14	3.18
	NR18MS 108	Bg	14-40	3.83
	NR18MS 108	Cg	40-100	4.30
	Lowest Detection Limit			**2.86**
	Highest Detection Limit			**5.20**
2019 soil survey baseline	EXP01 A	Ahe/Ae	0-19	3.39
	EXP01 B	Ahe/Ae	0-19	3.17
	EXP01 C	Ahe/Ae	0-17	3.53
	EXP02 A	Ae	0-13	3.17
	EXP02 B	Ahe/Ae	0-29	3.18
	EXP02 C	Ahe/Ae	0-24	3.08
	EXP03 A	Ahe/Ae	0-28	4.27
	EXP03 B	Ahe/Ae	0-25	3.75
	EXP03 C	Ahe/Ae	0-22	3.57
	REF04 A	Ahe/Ae	0-12	3.75
	REF04 B	Ae	0-12	3.93
	REF04 C	Ae	0-5	3.78
	REF05 A	Ahe/Ae	0-9	4.06
	REF05 B	Ae	0-5	3.80
	REF05 C	Ahe/Ae	0-10	3.76
	REF06 A	Ahe/Ae	0-23	3.42
	REF06 B	Ahe/Ae	0-59	3.59
	REF06 C	Ae	0-10	3.85
	Lowest Detection Limit			**3.08**
	Highest Detection Limit			**4.27**

cm = centimetre; CaCl2 = calcium chloride.

Table B-2: Soil Analytical Results (Saturated Paste Extractables)

Sampling Program	Sample	Horizon	Depth	pH	SAR[a]	Sodium	Calcium	Magnesium	Potassium	Conductivity Sat. Paste	Saturation
			cm	1:2 $CaCl_2$		mg/L	mg/L	mg/L	mg/L	dS/m	%
2018 soil survey baseline	NR18MS 58	AC	0-13	4.13	Incalculable	<5.0	<5.0	<5.0	5.6	<0.10	25.9
	NR18MS 58	Bm	13-34	4.56	Incalculable	14.5	<5.0	<5.0	<5.0	0.10	28.0
	NR18MS 58	Cg	34-100	5.20	Incalculable	<5.0	<5.0	<5.0	<5.0	<0.10	25.3
	NR18MS 77	Of	0-40	3.41	2.6	22.3	5.6	<5.0	9.4	0.18	941
	NR18MS 77	Om	40-95	3.17	0.83	9.7	10.3	<5.0	<5.0	0.15	601
	NR18MS 82	AC	0-7	4.09	<0.50	<5.0	7.3	<5.0	<5.0	<0.10	24.8
	NR18MS 82	Bj	7-35	4.54	Incalculable	<5.0	<5.0	<5.0	<5.0	<0.10	29.6
	NR18MS 96	LFH	9-0	2.86	<0.40	<5.0	10.2	<5.0	12.2	0.20	428
	NR18MS 96	AhC	0-5	3.20	0.64	5.6	5.9	<5.0	8.1	0.17	56.7
	NR18MS 96	Bmgj	5-24	4.24	Incalculable	<5.0	<5.0	<5.0	<5.0	<0.10	41.2
	NR18MS 96	BC	24-55	3.91	Incalculable	6.0	<5.0	<5.0	<5.0	<0.10	34.2
	NR18MS 96	C	55-100	4.33	Incalculable	<5.0	<5.0	<5.0	<5.0	<0.10	23.5
	NR18MS 108	LFH	4-0	3.22	<0.30	<5.0	17.4	6.7	35.6	0.29	247
	NR18MS 108	Aegj	0-14	3.18	Incalculable	<5.0	<5.0	<5.0	<5.0	<0.10	32.9
	NR18MS 108	Bg	14-40	3.83	Incalculable	<5.0	<5.0	<5.0	<5.0	<0.10	35.0
	NR18MS 108	Cg	40-100	4.30	Incalculable	<5.0	<5.0	<5.0	<5.0	<0.10	32.4
	Lowest Detection Limit			**2.86**	**0.30**	**5.0**	**5.0**	**5.0**	**5.0**	**0.10**	**1.0**
	Highest Detection Limit			**5.20**	**2.60**	**22.30**	**17.40**	**6.70**	**35.60**	**0.29**	**941.00**
2019 soil survey	EXP01 A	Ahe/Ae	0-19	3.39	0.2	2	10	3	8	0.19	29.2
	EXP01 B	Ahe/Ae	0-19	3.17	0.2	3	8	2	12	0.24	32.8
	EXP01 C	Ahe/Ae	0-17	3.53	2	22	5	2	11	0.25	31.2
	EXP02 A	Ae	0-13	3.17	0.2	2	6	3	7	0.23	27.9
	EXP02 B	Ahe/Ae	0-29	3.18	0.3	5	13	4	10	0.30	36.5
	EXP02 C	Ahe/Ae	0-24	3.08	0.7	6	5	2	11	0.35	37.0
	EXP03 A	Ahe/Ae	0-28	4.27	0.2	2	10	3	6	0.15	32.1
	EXP03 B	Ahe/Ae	0-25	3.75	0.5	6	10	2	10	0.17	23.2
	EXP03 C	Ahe/Ae	0-22	3.57	0.2	3	10	2	7	0.18	24.5
	REF04 A	Ahe/Ae	0-12	3.75	0.3	5	13	2	5	0.19	27.4
	REF04 B	Ae	0-12	3.93	0.1	3	20	3	6	0.22	31.2
	REF04 C	Ae	0-5	3.78	0.2	3	13	3	9	0.23	33.4
	REF05 A	Ahe/Ae	0-9	4.06	0.1	3	20	4	4	0.20	29.2
	REF05 B	Ae	0-5	3.80	0.2	4	18	6	7	0.24	34.5
	REF05 C	Ahe/Ae	0-10	3.76	0.3	5	14	5	6	0.24	38.7
	REF06 A	Ahe/Ae	0-23	3.42	0.2	2	10	2	6	0.16	29.0
	REF06 B	Ahe/Ae	0-59	3.59	0.1	3	24	5	22	0.32	36.6
	REF06 C	Ae	0-10	3.85	0.2	3	11	4	8	0.18	25.7
	Lowest Detection Limit			**3.08**	**0.1**	**2**	**5**	**2**	**4**	**0.15**	**23.20**
	Highest Detection Limit			**4.27**	**0.70**	**22**	**24**	**6**	**22**	**0.35**	**38.70**

a) Incalculable due to undetecable sodium, calcium, or magnesium. Detection limit represents maximum possible SAR value. Actual SAR values may be lower if both calcium and magnesium were detectable.

cm = centimetre; SAR = sodium adsorption ratio; $CaCl_2$ = calcium chloride; mg/L = miligrams per litre; dS/m^{-1} = deciSiemens per metre; % = percent; < = less than; - = not measured or incalculable.

Table B-3: Soil Cation Exchange Capacity Results

Sample	Horizon	Depth	Cation Exchange Capacity
		cm	mEq/100 g
NR18MS 58	AC	0-13	<0.80
NR18MS 58	Bm	13-34	-
NR18MS 58	Cg	34-100	-
NR18MS 77	Of	0-40	-
NR18MS 77	Om	40-95	-
NR18MS 82	AC	0-7	<0.80
NR18MS 82	Bj	7-35	-
NR18MS 96	LFH	9-0	-
NR18MS 96	AhC	0-5	7.68
NR18MS 96	Bmgj	5-24	-
NR18MS 96	BC	24-55	-
NR18MS 96	C	55-100	-
NR18MS 108	LFH	4-0	-
NR18MS 108	Aegj	0-14	<0.80
NR18MS 108	Bg	14-40	-
NR18MS 108	Cg	40-100	-
Lowest Detection Limit			**0.80**
Highest Detection Limit			**7.68**

cm = centimetre; mEq/100 g = milliequivalents per 100 grams; < = less than; - = not applicable.

Table B-4: Soil Analytical Results for Acid Base Accounting, Trace Metals, Short Term Leach Design, Mineralogical Testing (Leachable Metals)

Sampling Program	Sample	Horizon	Depth	Aluminum (Al)	Antimony (Sb)	Arsenic (As)	Barium (Ba)	Beryllium (Be)	Bismuth (Bi)	Boron (B)	Cadmium (Cd)	Calcium (Ca)	Chromium (Cr)	Cobalt (Co)	Copper (Cu)	Iron (Fe)	Lead (Pb)	Lithium (Li)	Magnesium (Mg)	Manganese (Mn)	Mercury (Hg)
			cm	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
2018 soil survey baseline	NR18MS 58	AC	0-13	187	<0.10	0.20	6.98	<0.10	<0.20	<5.0	<0.020	<50	<0.50	<0.10	<0.50	250	<0.50	<2.0	54	3.7	<0.0050
	NR18MS 58	Bm	13-34	4560	<0.10	0.64	10.2	<0.10	<0.20	<5.0	<0.020	64	3.62	0.38	2.98	3830	1.97	3.2	179	10.5	0.0232
	NR18MS 58	Cg	34-100	782	<0.10	0.41	3.82	<0.10	<0.20	<5.0	<0.020	<50	1.02	0.30	<0.50	1020	0.59	<2.0	98	7.1	<0.0050
	NR18MS 77	Of	0-40	3210	0.17	1.46	200	0.18	0.28	<5.0	0.339	7210	7.32	2.03	10.2	3210	3.87	3.3	1980	71.2	0.0763
	NR18MS 77	Om	40-95	2810	<0.10	0.61	266	0.18	<0.20	<5.0	0.275	5910	4.50	0.79	3.95	1490	0.66	<2.0	955	20.2	0.0716
	NR18MS 82	AC	0-7	354	<0.10	0.22	3.75	<0.10	<0.20	<5.0	<0.020	58	0.51	<0.10	<0.50	491	0.67	<2.0	31	14.7	<0.0050
	NR18MS 82	Bj	7-35	4760	<0.10	0.82	12.0	0.11	<0.20	<5.0	<0.020	92	3.95	0.57	1.91	4140	1.88	4.3	266	14.5	0.0211
	NR18MS 96	LFH	9-0	4140	<0.10	1.08	235	0.31	<0.20	<5.0	0.257	2870	3.40	0.70	6.82	2420	6.43	<2.0	324	33.6	0.0853
	NR18MS 96	AhC	0-5	1980	<0.10	0.52	17.3	<0.10	<0.20	<5.0	<0.020	83	2.93	0.16	0.91	1750	2.14	<2.0	136	6.2	0.0126
	NR18MS 96	Bmgj	5-24	7180	<0.10	0.97	22.3	0.16	<0.20	<5.0	<0.020	161	7.60	1.00	0.85	6350	2.44	4.6	688	20.3	0.0124
	NR18MS 96	BC	24-55	5460	<0.10	1.06	22.6	0.15	<0.20	<5.0	<0.020	136	8.47	1.25	0.89	5160	1.85	4.6	1010	24.8	0.0119
	NR18MS 96	C	55-100	1870	<0.10	0.59	8.46	<0.10	<0.20	<5.0	<0.020	104	2.81	0.58	0.57	1860	0.94	<2.0	324	19.7	<0.0050
	NR18MS 108	LFH	4-0	816	<0.10	0.51	69.9	<0.10	<0.20	<5.0	0.156	2090	1.63	0.24	3.29	854	3.37	<2.0	279	234	0.0642
	NR18MS 108	Aegj	0-14	130	<0.10	0.16	1.64	<0.10	<0.20	<5.0	<0.020	<50	<0.50	<0.10	<0.50	95	<0.50	<2.0	<20	<1.0	<0.0050
	NR18MS 108	Bg	14-40	1300	<0.10	0.83	3.62	<0.10	<0.20	<5.0	<0.020	63	1.72	0.13	<0.50	5090	<0.50	<2.0	55	1.6	<0.0050
	NR18MS 108	Cg	40-100	592	<0.10	0.27	2.85	<0.10	<0.20	<5.0	<0.020	55	0.93	<0.10	<0.50	353	<0.50	<2.0	47	1.2	<0.0050
	Lowest Detection Limit			**50**	**0.10**	**0.10**	**0.50**	**0.10**	**0.20**	**5.0**	**0.020**	**50**	**0.50**	**0.10**	**0.50**	**50**	**0.50**	**2.0**	**20**	**1.0**	**0.0050**
	Highest Detection Limit			**7180**	**0.17**	**1.46**	**266**	**0.31**	**0.28**	**5.0**	**0.34**	**7210**	**8.47**	**2.03**	**10.20**	**6350**	**6.43**	**4.60**	**1980**	**234**	**0.0853**
2019 soil survey	EXP01 A	Ahe/Ae	0-19	2030	<0.2	0.5	24	<0.1	<0.2	3	<0.1	140	3.0	0.2	<0.5	910	1.4	1.3	130	24	<0.05
	EXP01 B	Ahe/Ae	0-19	1680	<0.2	0.4	27	<0.1	<0.2	2	<0.1	170	2.9	0.2	<0.5	890	1.4	1.2	120	19	<0.05
	EXP01 C	Ahe/Ae	0-17	1190	<0.2	0.5	28	<0.1	<0.2	2	<0.1	160	1.7	<0.2	<0.5	630	1.5	0.7	70	18	<0.05
	EXP02 A	Ae	0-13	2220	<0.2	0.8	22	<0.1	<0.2	4	<0.1	150	5.3	2.5	<0.5	6200	1.6	3.5	110	74	<0.05
	EXP02 B	Ahe/Ae	0-29	2580	<0.2	0.8	27	<0.1	<0.2	4	<0.1	130	5.0	0.3	0.5	2940	1.6	1.8	130	40	<0.05
	EXP02 C	Ahe/Ae	0-24	2820	<0.2	0.7	30	<0.1	<0.2	5	<0.1	180	4.3	0.4	0.7	7300	1.8	1.9	160	110	<0.05
	EXP03 A	Ahe/Ae	0-28	1700	<0.2	0.5	17	<0.1	<0.2	3	<0.1	130	4.7	<0.2	<0.5	840	1.4	1.4	110	16	<0.05
	EXP03 B	Ahe/Ae	0-25	1060	<0.2	0.4	16	<0.1	<0.2	2	<0.1	130	2.1	0.4	<0.5	600	1.3	0.8	70	12	<0.05
	EXP03 C	Ahe/Ae	0-22	940	<0.2	0.4	14	<0.1	<0.2	<1	<0.1	160	1.5	<0.2	<0.5	570	1.2	0.6	80	22	<0.05
	REF04 A	Ahe/Ae	0-12	3650	<0.2	0.9	28	<0.1	<0.2	3	<0.1	330	4.2	0.5	0.8	2870	2.4	3.9	360	35	<0.05
	REF04 B	Ae	0-12	2440	<0.2	0.5	31	<0.1	<0.2	2	<0.1	290	3.6	0.2	<0.5	1590	1.8	1.8	180	34	<0.05
	REF04 C	Ae	0-5	2530	<0.2	0.7	24	<0.1	<0.2	2	<0.1	280	2.8	0.5	<0.5	1420	1.7	2.3	200	43	<0.05
	REF05 A	Ahe/Ae	0-9	4750	<0.2	0.8	41	<0.1	<0.2	2	<0.1	550	5.8	0.9	1.0	4770	2.3	3.6	490	70	<0.05
	REF05 B	Ae	0-5	5200	<0.2	0.8	33	<0.1	<0.2	3	<0.1	540	7.2	0.8	1.0	4900	2.4	4.2	570	60	<0.05
	REF05 C	Ahe/Ae	0-10	5400	<0.2	0.9	30	<0.1	<0.2	2	<0.1	510	8.1	1.1	0.9	5400	2.6	4.1	540	56	<0.05
	REF06 A	Ahe/Ae	0-23	850	<0.2	0.4	15	<0.1	<0.2	2	<0.1	150	16	0.4	0.6	480	1.3	0.6	60	18	<0.05
	REF06 B	Ahe/Ae	0-59	840	<0.2	0.4	17	<0.1	<0.2	3	<0.1	200	4.6	0.9	<0.5	330	1.4	0.6	60	21	<0.05
	REF06 C	Ae	0-10	3690	<0.2	0.7	28	<0.1	<0.2	4	<0.1	310	3.9	0.5	0.7	2150	2.1	2.6	240	26	<0.05
	Lowest Detection Limit			**0.5**	**0.2**	**0.1**	**0.5**	**0.1**	**0.2**	**1.0**	**0.1**	**10.0**	**0.5**	**0.2**	**0.5**	**0.5**	**0.1**	**0.1**	**10.0**	**0.5**	**0.1**
	Highest Detection Limit			**5400**	**0.2**	**0.9**	**41**	**0.1**	**0.2**	**5.0**	**0.1**	**550**	**16**	**2.5**	**1.00**	**7300**	**2.6**	**4.2**	**570**	**110**	**0.05**

mg/kg = milligram per kilogram; < = less than

Table B-4: Soil Analytical Results for Acid Base Accounting, Trace Metals, Short Term Leach Design, Mineralogical Testing (Leachable Metals)

Sampling Program	Sample	Horizon	Depth	Molybdenum (Mo)	Nickel (Ni)	Phosphorus (P)	Potassium (K)	Selenium (Se)	Silver (Ag)	Sodium (Na)	Strontium (Sr)	Sulfate (SO_4)	Sulfur (S)	Thallium (Tl)	Tin (Sn)	Titanium (Ti)	Tungsten (W)	Uranium (U)	Vanadium (V)	Zinc (Zn)	Zirconium (Zr)
			cm	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
2018 soil survey baseline	NR18MS 58	AC	0-13	<0.10	<0.50	<50	<100	<0.20	<0.10	<50	1.75	-	<1000	<0.050	<1.0	25.5	0.62	<0.050	0.68	<2.0	<1.0
	NR18MS 58	Bm	13-34	0.15	1.06	373	<100	<0.20	<0.10	<50	4.10	-	<1000	<0.050	<1.0	78.0	<0.50	0.158	8.52	16.8	1.7
	NR18MS 58	Cg	34-100	<0.10	0.62	<50	<100	<0.20	<0.10	<50	3.88	-	<1000	<0.050	<1.0	29.5	<0.50	0.086	1.92	2.1	1.0
	NR18MS 77	Of	0-40	4.09	9.10	545	660	0.29	0.78	567	71.5	-	1900	<0.050	<1.0	11.4	13.3	30.9	5.86	28.1	2.5
	NR18MS 77	Om	40-95	0.56	5.90	504	160	0.33	0.12	154	52.6	-	2400	<0.050	<1.0	20.9	<0.50	0.794	4.37	20.9	<1.0
	NR18MS 82	AC	0-7	<0.10	<0.50	<50	<100	<0.20	<0.10	<50	1.78	-	<1000	<0.050	<1.0	25.9	<0.50	<0.050	1.28	<2.0	<1.0
	NR18MS 82	Bj	7-35	0.12	1.41	242	<100	<0.20	<0.10	<50	3.89	-	<1000	<0.050	<1.0	99.4	<0.50	0.214	8.42	8.1	1.8
	NR18MS 96	LFH	9-0	0.34	4.39	814	400	0.38	<0.10	<50	33.2	-	<1000	<0.050	<1.0	18.0	<0.50	0.181	4.32	10.6	<1.0
	NR18MS 96	AhC	0-5	<0.10	0.61	109	<100	<0.20	<0.10	<50	2.84	-	<1000	<0.050	<1.0	13.8	<0.50	0.180	4.31	2.6	<1.0
	NR18MS 96	Bmgj	5-24	0.13	2.18	145	120	<0.20	<0.10	<50	5.40	-	<1000	<0.050	<1.0	161	<0.50	0.348	11.9	5.6	<1.0
	NR18MS 96	BC	24-55	0.16	3.11	68	160	<0.20	<0.10	<50	7.95	-	<1000	<0.050	<1.0	197	<0.50	0.397	11.9	6.5	3.2
	NR18MS 96	C	55-100	<0.10	1.28	55	130	<0.20	<0.10	<50	6.47	-	<1000	<0.050	<1.0	60.9	<0.50	0.157	4.45	2.7	1.3
	NR18MS 108	LFH	4-0	0.24	1.53	410	450	<0.20	<0.10	<50	9.07	-	<1000	<0.050	<1.0	15.9	<0.50	0.060	1.90	17.4	<1.0
	NR18MS 108	Aegj	0-14	<0.10	<0.50	<50	<100	<0.20	<0.10	<50	2.09	-	<1000	<0.050	<1.0	7.7	<0.50	<0.050	0.27	<2.0	<1.0
	NR18MS 108	Bg	14-40	0.11	<0.50	57	<100	<0.20	<0.10	<50	2.84	-	<1000	<0.050	<1.0	24.5	<0.50	0.103	7.69	<2.0	<1.0
	NR18MS 108	Cg	40-100	<0.10	<0.50	51	<100	<0.20	<0.10	<50	3.53	-	<1000	<0.050	<1.0	18.2	<0.50	0.078	1.21	<2.0	<1.0
	Lowest Detection Limit			**0.10**	**0.50**	**50**	**100**	**0.20**	**0.10**	**50**	**0.50**	**-**	**1000**	**0.050**	**1.0**	**1.0**	**0.50**	**0.050**	**0.20**	**2.0**	**1.0**
	Highest Detection Limit			**4.09**	**9.10**	**814**	**660**	**0.38**	**0.78**	**567**	**71.50**	**-**	**2400**	**0.050**	**1.0**	**197**	**13.3**	**30.90**	**11.90**	**28.10**	**3.2**
2019 soil survey	EXP01 A	Ahe/Ae	0-19	<0.1	0.5	40	620	<0.1	<0.1	110	15	18	-	<0.2	<0.1	210	<0.5	0.2	3.1	1.7	13
	EXP01 B	Ahe/Ae	0-19	<0.1	0.4	40	560	<0.1	<0.1	120	16	20	-	<0.2	<0.1	220	<0.5	0.3	3.4	1.8	17
	EXP01 C	Ahe/Ae	0-17	<0.1	0.3	40	460	<0.1	<0.1	130	16	20	-	<0.2	<0.1	130	<0.5	0.2	2.0	2.2	13
	EXP02 A	Ae	0-13	0.1	2.0	130	560	<0.1	<0.1	80	24	23	-	<0.2	<0.1	160	<0.5	0.3	4.4	2.4	13
	EXP02 B	Ahe/Ae	0-29	0.1	0.7	70	580	<0.1	<0.1	80	17	32	-	<0.2	0.1	280	<0.5	0.3	5.2	2.5	16
	EXP02 C	Ahe/Ae	0-24	0.2	1.2	110	710	<0.1	<0.1	140	20	31	-	<0.2	0.1	240	<0.5	0.3	5.4	3.2	16
	EXP03 A	Ahe/Ae	0-28	0.2	1.4	40	450	<0.1	<0.1	120	18	10	-	<0.2	<0.1	140	<0.5	0.2	2.3	0.9	16
	EXP03 B	Ahe/Ae	0-25	<0.1	0.4	40	360	<0.1	<0.1	100	18	12	-	<0.2	<0.1	120	<0.5	0.2	1.8	1.0	14
	EXP03 C	Ahe/Ae	0-22	<0.1	0.3	30	320	<0.1	<0.1	120	14	12	-	<0.2	<0.1	130	<0.5	0.2	1.7	1.9	9.2
	REF04 A	Ahe/Ae	0-12	<0.1	1.2	70	630	<0.1	<0.1	100	32	10	-	<0.2	0.2	280	<0.5	0.3	8.3	5.4	18
	REF04 B	Ae	0-12	0.1	0.9	80	630	<0.1	<0.1	110	17	13	-	<0.2	0.1	200	<0.5	0.2	4.9	3.8	14
	REF04 C	Ae	0-5	<0.1	0.9	50	600	<0.1	<0.1	150	20	11	-	<0.2	<0.1	130	<0.5	0.2	3.5	3.3	10
	REF05 A	Ahe/Ae	0-9	0.1	1.7	90	770	<0.1	<0.1	150	18	12	-	<0.2	0.2	360	<0.5	0.3	10	7.1	17
	REF05 B	Ae	0-5	0.2	2.1	80	610	<0.1	<0.1	110	17	10	-	<0.2	4.2	420	<0.5	0.4	13	5.5	17
	REF05 C	Ahe/Ae	0-10	0.2	2.2	120	500	<0.1	<0.1	120	16	14	-	<0.2	0.3	460	<0.5	0.4	14	7.4	17
	REF06 A	Ahe/Ae	0-23	1.8	7.4	40	330	<0.1	<0.1	120	13	14	-	<0.2	<0.1	75	<0.5	0.2	1.3	1.4	8.6
	REF06 B	Ahe/Ae	0-59	0.2	2.0	40	250	<0.1	<0.1	80	15	27	-	<0.2	<0.1	61	<0.5	0.2	1.1	2.8	8.7
	REF06 C	Ae	0-10	<0.1	0.9	160	1600	<0.1	<0.1	870	18	6	-	<0.2	0.1	150	<0.5	0.2	5.5	3.9	14
	Lowest Detection Limit			**0.1**	**0.1**	**10**	**10**	**0.1**	**0.1**	**10**	**0.50**	**2**	**-**	**0.2**	**0.1**	**0.5**	**0.5**	**0.1**	**0.1**	**0.5**	**0.1**
	Highest Detection Limit			**1.80**	**7.4**	**160**	**1600**	**0.1**	**0.1**	**870**	**32**	**32**	**-**	**0.2**	**4.2**	**460**	**0.5**	**0.40**	**14**	**7.40**	**18.0**

cm = centimetre; mg/kg = milligram per kilogram; < = less than; - not measured.

Source: CCME (2014); Based on soil chemistry results from the 2018 and 2019 field programs, concentrations of samples are considered to be below Canadian Council of Ministers of the Environment Soil Quality Guidelines for the Protection of Environmental and Human Heath.

Table B-5: Soil Analytical Results for Particle Size

Sample	Horizon	Depth	% Sand	% Silt	% Clay	Texture
		cm	(2.0 mm - 0.05 mm)	(0.05 mm - 2 μm)	<2 μm	
NR18MS 58	AC	0-13	94.0	5.8	<1.0	Sand
NR18MS 58	Bm	13-34	83.7	15.9	<1.0	Loamy sand
NR18MS 58	Cg	34-100	96.3	3.6	<1.0	Sand
NR18MS 77	Of	0-40	-	-	-	-
NR18MS 77	Om	40-95	-	-	-	-
NR18MS 82	AC	0-7	91.0	8.9	<1.0	Sand
NR18MS 82	Bj	7-35	74.3	24.8	<1.0	Loamy sand
NR18MS 96	LFH	9-0	-	-	-	-
NR18MS 96	AhC	0-5	27.9	69.6	2.5	Silt loam
NR18MS 96	Bmgj	5-24	26.3	71.6	2.1	Silt loam
NR18MS 96	BC	24-55	28.5	67.7	3.8	Silt loam
NR18MS 96	C	55-100	81.3	17.9	<1.0	Loamy sand
NR18MS 108	LFH	4-0	-	-	-	-
NR18MS 108	Aegj	0-14	94.8	5.1	<1.0	Sand
NR18MS 108	Bg	14-40	93.4	5.6	1.0	Sand
NR18MS 108	Cg	40-100	98.9	<1.0	<1.0	Sand
Lowest Detection Limit		-	1.0	1.0	1.0	-

cm = centimetre; % = percent; mm = millimetre; μm = micrometre; < = less than; - = not applicable.

Table B-6: Baseline Total Radionuclides in Soil at the 2019 Soil Monitoring Program Reference and Exposure Locations

Sampling Program	Sample	Horizon	Depth	Lead-210	Polonium-210	Radium-226	Thorium-228	Thorium-230	Thorium-232
			cm	Bq/g	Bq/g	Bq/g	Bq/g	Bq/g	Bq/g
2019 soil survey	EXP01 A	Ahe/Ae	0-19	< 0.04	0.01	0.02	<0.02	<0.02	<0.02
	EXP01 B	Ahe/Ae	0-19	< 0.04	< 0.01	0.02	<0.02	<0.02	<0.02
	EXP01 C	Ahe/Ae	0-17	< 0.04	< 0.01	0.01	<0.02	<0.02	<0.02
	EXP02 A	Ae	0-13	< 0.04	0.01	< 0.01	<0.02	<0.02	<0.02
	EXP02 B	Ahe/Ae	0-29	< 0.04	< 0.01	0.02	<0.02	<0.02	<0.02
	EXP02 C	Ahe/Ae	0-24	< 0.04	< 0.01	0.02	<0.02	<0.02	<0.02
	EXP03 A	Ahe/Ae	0-28	< 0.04	< 0.01	0.02	<0.02	<0.02	<0.02
	EXP03 B	Ahe/Ae	0-25	< 0.04	< 0.01	< 0.01	<0.02	<0.02	<0.02
	EXP03 C	Ahe/Ae	0-22	< 0.04	< 0.01	< 0.01	<0.02	<0.02	<0.02
	REF04 A	Ahe/Ae	0-12	< 0.04	< 0.01	0.02	<0.02	<0.02	<0.02
	REF04 B	Ae	0-12	< 0.04	0.01	0.02	<0.02	<0.02	<0.02
	REF04 C	Ae	0-5	< 0.04	0.01	0.02	<0.02	<0.02	<0.02
	REF05 A	Ahe/Ae	0-9	< 0.04	0.02	0.02	<0.02	<0.02	<0.02
	REF05 B	Ae	0-5	< 0.04	0.01	0.02	<0.02	<0.02	<0.02
	REF05 C	Ahe/Ae	0-10	< 0.04	< 0.01	0.02	<0.02	<0.02	<0.02
	REF06 A	Ahe/Ae	0-23	< 0.04	< 0.01	0.03	<0.02	<0.02	<0.02
	REF06 B	Ahe/Ae	0-59	< 0.04	0.02	0.03	<0.02	<0.02	<0.02
	REF06 C	Ae	0-10	< 0.04	0.02	0.02	<0.02	<0.02	<0.02
	Lowest Detection Limit			0.04	0.01	0.01	0.02	0.02	0.02

cm = centimentre; Bq/g = becquerels per gram; < = less than.

Golder Associates Ltd.
ATTN: KYLE HODGSON
1721 8th Street East
Saskatoon SK S7H 0T4

Date Received: 19-OCT-18
Report Date: 14-NOV-18 14:58 (MT)
Version: FINAL

Client Phone: 306-665-7989

Certificate of Analysis

Lab Work Order #: L2183989
Project P.O. #: NOT SUBMITTED
Job Reference:
C of C Numbers:
Legal Site Desc:

Brian Morgan, B.Sc. Hons.
Client Services Manager

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ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2183989-1 NR18MS 108 LFH (4-0)							
Sampled By: CLIENT on 16-OCT-18 @ 12:00							
Matrix: SOIL							
Miscellaneous Parameters							
Mercury (Hg)	0.0642		0.0050	mg/kg	06-NOV-18	06-NOV-18	R4322916
% Saturation	247		1.0	%	05-NOV-18	06-NOV-18	R4322487
Metals in Soil by CRC ICPMS							
Aluminum (Al)	816		50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Antimony (Sb)	<0.10		0.10	mg/kg	06-NOV-18	14-NOV-18	R4333729
Arsenic (As)	0.51		0.10	mg/kg	06-NOV-18	14-NOV-18	R4333729
Barium (Ba)	69.9		0.50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Beryllium (Be)	<0.10		0.10	mg/kg	06-NOV-18	14-NOV-18	R4333729
Boron (B)	<5.0		5.0	mg/kg	06-NOV-18	14-NOV-18	R4333729
Bismuth (Bi)	<0.20		0.20	mg/kg	06-NOV-18	14-NOV-18	R4333729
Cadmium (Cd)	0.156		0.020	mg/kg	06-NOV-18	14-NOV-18	R4333729
Calcium (Ca)	2090		50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Chromium (Cr)	1.63		0.50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Cobalt (Co)	0.24		0.10	mg/kg	06-NOV-18	14-NOV-18	R4333729
Copper (Cu)	3.29		0.50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Iron (Fe)	854		50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Lead (Pb)	3.37		0.50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Lithium (Li)	<2.0		2.0	mg/kg	06-NOV-18	14-NOV-18	R4333729
Magnesium (Mg)	279		20	mg/kg	06-NOV-18	14-NOV-18	R4333729
Manganese (Mn)	234		1.0	mg/kg	06-NOV-18	14-NOV-18	R4333729
Molybdenum (Mo)	0.24		0.10	mg/kg	06-NOV-18	14-NOV-18	R4333729
Nickel (Ni)	1.53		0.50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Phosphorus (P)	410		50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Potassium (K)	450		100	mg/kg	06-NOV-18	14-NOV-18	R4333729
Selenium (Se)	<0.20		0.20	mg/kg	06-NOV-18	14-NOV-18	R4333729
Silver (Ag)	<0.10		0.10	mg/kg	06-NOV-18	14-NOV-18	R4333729
Sodium (Na)	<50		50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Strontium (Sr)	9.07		0.50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Sulfur (S)	<1000		1000	mg/kg	06-NOV-18	14-NOV-18	R4333729
Thallium (Tl)	<0.050		0.050	mg/kg	06-NOV-18	14-NOV-18	R4333729
Tin (Sn)	<1.0		1.0	mg/kg	06-NOV-18	14-NOV-18	R4333729
Titanium (Ti)	15.9		1.0	mg/kg	06-NOV-18	14-NOV-18	R4333729
Tungsten (W)	<0.50		0.50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Uranium (U)	0.060		0.050	mg/kg	06-NOV-18	14-NOV-18	R4333729
Vanadium (V)	1.90		0.20	mg/kg	06-NOV-18	14-NOV-18	R4333729
Zinc (Zn)	17.4		2.0	mg/kg	06-NOV-18	14-NOV-18	R4333729
Zirconium (Zr)	<1.0		1.0	mg/kg	06-NOV-18	14-NOV-18	R4333729
Basic Salinity							
EC (Saturated Paste)							
Conductivity Sat. Paste	0.29		0.10	dS m-1	05-NOV-18	06-NOV-18	R4322487
SAR and Cations in saturated soil							
Calcium (Ca)	17.4		5.0	mg/L	06-NOV-18	06-NOV-18	R4322910
Potassium (K)	35.6		5.0	mg/L	06-NOV-18	06-NOV-18	R4322910
Magnesium (Mg)	6.7		5.0	mg/L	06-NOV-18	06-NOV-18	R4322910
Sodium (Na)	<5.0		5.0	mg/L	06-NOV-18	06-NOV-18	R4322910
SAR	<0.30	SAR:DL	0.30	SAR	06-NOV-18	06-NOV-18	R4322910
pH (1:2 Soil:CaCl2 Extraction)							
pH (1:2 CaCl2)	3.22		0.10	pH	06-NOV-18	06-NOV-18	R4321628
L2183989-2 NR18MS 108 AEGJ (0-14)							
Sampled By: CLIENT on 16-OCT-18 @ 12:00							
Matrix: SOIL							

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2183989-2 NR18MS 108 AEGJ (0-14)							
Sampled By: CLIENT on 16-OCT-18 @ 12:00							
Matrix: SOIL							
Miscellaneous Parameters							
Cation Exchange Capacity	<0.80		0.80	meq/100g	08-NOV-18	08-NOV-18	R4326328
Mercury (Hg)	<0.0050		0.0050	mg/kg	06-NOV-18	06-NOV-18	R4322916
% Saturation	32.9		1.0	%	05-NOV-18	06-NOV-18	R4322487
Particle Size Analysis:Mini-Pipet Method							
% Sand (2.0mm - 0.05mm)	94.8		1.0	%	05-NOV-18	06-NOV-18	R4322698
% Silt (0.05mm - 2um)	5.1		1.0	%	05-NOV-18	06-NOV-18	R4322698
% Clay (<2um)	<1.0		1.0	%	05-NOV-18	06-NOV-18	R4322698
Texture	Sand				05-NOV-18	06-NOV-18	R4322698
Metals in Soil by CRC ICPMS							
Aluminum (Al)	130		50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Antimony (Sb)	<0.10		0.10	mg/kg	06-NOV-18	14-NOV-18	R4333729
Arsenic (As)	0.16		0.10	mg/kg	06-NOV-18	14-NOV-18	R4333729
Barium (Ba)	1.64		0.50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Beryllium (Be)	<0.10		0.10	mg/kg	06-NOV-18	14-NOV-18	R4333729
Boron (B)	<5.0		5.0	mg/kg	06-NOV-18	14-NOV-18	R4333729
Bismuth (Bi)	<0.20		0.20	mg/kg	06-NOV-18	14-NOV-18	R4333729
Cadmium (Cd)	<0.020		0.020	mg/kg	06-NOV-18	14-NOV-18	R4333729
Calcium (Ca)	<50		50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Chromium (Cr)	<0.50		0.50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Cobalt (Co)	<0.10		0.10	mg/kg	06-NOV-18	14-NOV-18	R4333729
Copper (Cu)	<0.50		0.50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Iron (Fe)	95		50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Lead (Pb)	<0.50		0.50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Lithium (Li)	<2.0		2.0	mg/kg	06-NOV-18	14-NOV-18	R4333729
Magnesium (Mg)	<20		20	mg/kg	06-NOV-18	14-NOV-18	R4333729
Manganese (Mn)	<1.0		1.0	mg/kg	06-NOV-18	14-NOV-18	R4333729
Molybdenum (Mo)	<0.10		0.10	mg/kg	06-NOV-18	14-NOV-18	R4333729
Nickel (Ni)	<0.50		0.50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Phosphorus (P)	<50		50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Potassium (K)	<100		100	mg/kg	06-NOV-18	14-NOV-18	R4333729
Selenium (Se)	<0.20		0.20	mg/kg	06-NOV-18	14-NOV-18	R4333729
Silver (Ag)	<0.10		0.10	mg/kg	06-NOV-18	14-NOV-18	R4333729
Sodium (Na)	<50		50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Strontium (Sr)	2.09		0.50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Sulfur (S)	<1000		1000	mg/kg	06-NOV-18	14-NOV-18	R4333729
Thallium (Tl)	<0.050		0.050	mg/kg	06-NOV-18	14-NOV-18	R4333729
Tin (Sn)	<1.0		1.0	mg/kg	06-NOV-18	14-NOV-18	R4333729
Titanium (Ti)	7.7		1.0	mg/kg	06-NOV-18	14-NOV-18	R4333729
Tungsten (W)	<0.50		0.50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Uranium (U)	<0.050		0.050	mg/kg	06-NOV-18	14-NOV-18	R4333729
Vanadium (V)	0.27		0.20	mg/kg	06-NOV-18	14-NOV-18	R4333729
Zinc (Zn)	<2.0		2.0	mg/kg	06-NOV-18	14-NOV-18	R4333729
Zirconium (Zr)	<1.0		1.0	mg/kg	06-NOV-18	14-NOV-18	R4333729
Basic Salinity							
EC (Saturated Paste)							
Conductivity Sat. Paste	<0.10		0.10	dS m-1	05-NOV-18	06-NOV-18	R4322487
SAR and Cations in saturated soil							
Calcium (Ca)	<5.0		5.0	mg/L	06-NOV-18	06-NOV-18	R4322910
Potassium (K)	<5.0		5.0	mg/L	06-NOV-18	06-NOV-18	R4322910
Magnesium (Mg)	<5.0		5.0	mg/L	06-NOV-18	06-NOV-18	R4322910
Sodium (Na)	<5.0		5.0	mg/L	06-NOV-18	06-NOV-18	R4322910

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2183989-2 NR18MS 108 AEGJ (0-14)							
Sampled By: CLIENT on 16-OCT-18 @ 12:00							
Matrix: SOIL							
SAR and Cations in saturated soil							
SAR	Incalculable	SAR:INC	0.10	SAR	06-NOV-18	06-NOV-18	R4322910
pH (1:2 Soil:CaCl2 Extraction)							
pH (1:2 CaCl2)	3.18		0.10	pH	06-NOV-18	06-NOV-18	R4321628
L2183989-3 NR18MS 108 BG (14-40)							
Sampled By: CLIENT on 16-OCT-18 @ 12:00							
Matrix: SOIL							
Miscellaneous Parameters							
Mercury (Hg)	<0.0050		0.0050	mg/kg	06-NOV-18	06-NOV-18	R4322916
% Saturation	35.0		1.0	%	05-NOV-18	06-NOV-18	R4322487
Particle Size Analysis:Mini-Pipet Method							
% Sand (2.0mm - 0.05mm)	93.4		1.0	%	05-NOV-18	06-NOV-18	R4322698
% Silt (0.05mm - 2um)	5.6		1.0	%	05-NOV-18	06-NOV-18	R4322698
% Clay (<2um)	1.0		1.0	%	05-NOV-18	06-NOV-18	R4322698
Texture	Sand				05-NOV-18	06-NOV-18	R4322698
Metals in Soil by CRC ICPMS							
Aluminum (Al)	1300		50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Antimony (Sb)	<0.10		0.10	mg/kg	06-NOV-18	14-NOV-18	R4333729
Arsenic (As)	0.83		0.10	mg/kg	06-NOV-18	14-NOV-18	R4333729
Barium (Ba)	3.62		0.50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Beryllium (Be)	<0.10		0.10	mg/kg	06-NOV-18	14-NOV-18	R4333729
Boron (B)	<5.0		5.0	mg/kg	06-NOV-18	14-NOV-18	R4333729
Bismuth (Bi)	<0.20		0.20	mg/kg	06-NOV-18	14-NOV-18	R4333729
Cadmium (Cd)	<0.020		0.020	mg/kg	06-NOV-18	14-NOV-18	R4333729
Calcium (Ca)	63		50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Chromium (Cr)	1.72		0.50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Cobalt (Co)	0.13		0.10	mg/kg	06-NOV-18	14-NOV-18	R4333729
Copper (Cu)	<0.50		0.50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Iron (Fe)	5090		50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Lead (Pb)	<0.50		0.50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Lithium (Li)	<2.0		2.0	mg/kg	06-NOV-18	14-NOV-18	R4333729
Magnesium (Mg)	55		20	mg/kg	06-NOV-18	14-NOV-18	R4333729
Manganese (Mn)	1.6		1.0	mg/kg	06-NOV-18	14-NOV-18	R4333729
Molybdenum (Mo)	0.11		0.10	mg/kg	06-NOV-18	14-NOV-18	R4333729
Nickel (Ni)	<0.50		0.50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Phosphorus (P)	57		50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Potassium (K)	<100		100	mg/kg	06-NOV-18	14-NOV-18	R4333729
Selenium (Se)	<0.20		0.20	mg/kg	06-NOV-18	14-NOV-18	R4333729
Silver (Ag)	<0.10		0.10	mg/kg	06-NOV-18	14-NOV-18	R4333729
Sodium (Na)	<50		50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Strontium (Sr)	2.84		0.50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Sulfur (S)	<1000		1000	mg/kg	06-NOV-18	14-NOV-18	R4333729
Thallium (Tl)	<0.050		0.050	mg/kg	06-NOV-18	14-NOV-18	R4333729
Tin (Sn)	<1.0		1.0	mg/kg	06-NOV-18	14-NOV-18	R4333729
Titanium (Ti)	24.5		1.0	mg/kg	06-NOV-18	14-NOV-18	R4333729
Tungsten (W)	<0.50		0.50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Uranium (U)	0.103		0.050	mg/kg	06-NOV-18	14-NOV-18	R4333729
Vanadium (V)	7.69		0.20	mg/kg	06-NOV-18	14-NOV-18	R4333729
Zinc (Zn)	<2.0		2.0	mg/kg	06-NOV-18	14-NOV-18	R4333729
Zirconium (Zr)	<1.0		1.0	mg/kg	06-NOV-18	14-NOV-18	R4333729
Basic Salinity							
EC (Saturated Paste)							

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2183989-3 NR18MS 108 BG (14-40)							
Sampled By: CLIENT on 16-OCT-18 @ 12:00							
Matrix: SOIL							
EC (Saturated Paste)							
Conductivity Sat. Paste	<0.10		0.10	dS m-1	05-NOV-18	06-NOV-18	R4322487
SAR and Cations in saturated soil							
Calcium (Ca)	<5.0		5.0	mg/L	06-NOV-18	06-NOV-18	R4322910
Potassium (K)	<5.0		5.0	mg/L	06-NOV-18	06-NOV-18	R4322910
Magnesium (Mg)	<5.0		5.0	mg/L	06-NOV-18	06-NOV-18	R4322910
Sodium (Na)	<5.0		5.0	mg/L	06-NOV-18	06-NOV-18	R4322910
SAR	Incalculable	SAR:INC	0.10	SAR	06-NOV-18	06-NOV-18	R4322910
pH (1:2 Soil:CaCl2 Extraction)							
pH (1:2 CaCl2)	3.83		0.10	pH	06-NOV-18	06-NOV-18	R4321628
L2183989-4 NR18MS 108 CG (40-100)							
Sampled By: CLIENT on 16-OCT-18 @ 12:00							
Matrix: SOIL							
Miscellaneous Parameters							
Mercury (Hg)	<0.0050		0.0050	mg/kg	06-NOV-18	06-NOV-18	R4322916
% Saturation	32.4		1.0	%	05-NOV-18	06-NOV-18	R4322487
Particle Size Analysis:Mini-Pipet Method							
% Sand (2.0mm - 0.05mm)	98.9		1.0	%	05-NOV-18	06-NOV-18	R4322698
% Silt (0.05mm - 2um)	<1.0		1.0	%	05-NOV-18	06-NOV-18	R4322698
% Clay (<2um)	<1.0		1.0	%	05-NOV-18	06-NOV-18	R4322698
Texture	Sand				05-NOV-18	06-NOV-18	R4322698
Metals in Soil by CRC ICPMS							
Aluminum (Al)	592		50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Antimony (Sb)	<0.10		0.10	mg/kg	06-NOV-18	14-NOV-18	R4333729
Arsenic (As)	0.27		0.10	mg/kg	06-NOV-18	14-NOV-18	R4333729
Barium (Ba)	2.85		0.50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Beryllium (Be)	<0.10		0.10	mg/kg	06-NOV-18	14-NOV-18	R4333729
Boron (B)	<5.0		5.0	mg/kg	06-NOV-18	14-NOV-18	R4333729
Bismuth (Bi)	<0.20		0.20	mg/kg	06-NOV-18	14-NOV-18	R4333729
Cadmium (Cd)	<0.020		0.020	mg/kg	06-NOV-18	14-NOV-18	R4333729
Calcium (Ca)	55		50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Chromium (Cr)	0.93		0.50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Cobalt (Co)	<0.10		0.10	mg/kg	06-NOV-18	14-NOV-18	R4333729
Copper (Cu)	<0.50		0.50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Iron (Fe)	353		50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Lead (Pb)	<0.50		0.50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Lithium (Li)	<2.0		2.0	mg/kg	06-NOV-18	14-NOV-18	R4333729
Magnesium (Mg)	47		20	mg/kg	06-NOV-18	14-NOV-18	R4333729
Manganese (Mn)	1.2		1.0	mg/kg	06-NOV-18	14-NOV-18	R4333729
Molybdenum (Mo)	<0.10		0.10	mg/kg	06-NOV-18	14-NOV-18	R4333729
Nickel (Ni)	<0.50		0.50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Phosphorus (P)	51		50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Potassium (K)	<100		100	mg/kg	06-NOV-18	14-NOV-18	R4333729
Selenium (Se)	<0.20		0.20	mg/kg	06-NOV-18	14-NOV-18	R4333729
Silver (Ag)	<0.10		0.10	mg/kg	06-NOV-18	14-NOV-18	R4333729
Sodium (Na)	<50		50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Strontium (Sr)	3.53		0.50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Sulfur (S)	<1000		1000	mg/kg	06-NOV-18	14-NOV-18	R4333729
Thallium (Tl)	<0.050		0.050	mg/kg	06-NOV-18	14-NOV-18	R4333729
Tin (Sn)	<1.0		1.0	mg/kg	06-NOV-18	14-NOV-18	R4333729
Titanium (Ti)	18.2		1.0	mg/kg	06-NOV-18	14-NOV-18	R4333729
Tungsten (W)	<0.50		0.50	mg/kg	06-NOV-18	14-NOV-18	R4333729

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2183989-4 NR18MS 108 CG (40-100)							
Sampled By: CLIENT on 16-OCT-18 @ 12:00							
Matrix: SOIL							
Metals in Soil by CRC ICPMS							
Uranium (U)	0.078		0.050	mg/kg	06-NOV-18	14-NOV-18	R4333729
Vanadium (V)	1.21		0.20	mg/kg	06-NOV-18	14-NOV-18	R4333729
Zinc (Zn)	<2.0		2.0	mg/kg	06-NOV-18	14-NOV-18	R4333729
Zirconium (Zr)	<1.0		1.0	mg/kg	06-NOV-18	14-NOV-18	R4333729
Basic Salinity							
EC (Saturated Paste)							
Conductivity Sat. Paste	<0.10		0.10	dS m-1	05-NOV-18	06-NOV-18	R4322487
SAR and Cations in saturated soil							
Calcium (Ca)	<5.0		5.0	mg/L	06-NOV-18	06-NOV-18	R4322910
Potassium (K)	<5.0		5.0	mg/L	06-NOV-18	06-NOV-18	R4322910
Magnesium (Mg)	<5.0		5.0	mg/L	06-NOV-18	06-NOV-18	R4322910
Sodium (Na)	<5.0		5.0	mg/L	06-NOV-18	06-NOV-18	R4322910
SAR	Incalculable	SAR:INC	0.10	SAR	06-NOV-18	06-NOV-18	R4322910
pH (1:2 Soil:CaCl2 Extraction)							
pH (1:2 CaCl2)	4.30		0.10	pH	06-NOV-18	06-NOV-18	R4321628
L2183989-5 NR18MS 77 OF (0-40)							
Sampled By: CLIENT on 14-OCT-18 @ 12:00							
Matrix: SOIL							
Miscellaneous Parameters							
Mercury (Hg)	0.0763		0.0050	mg/kg	06-NOV-18	06-NOV-18	R4322916
% Saturation	941		1.0	%	05-NOV-18	06-NOV-18	R4322487
Metals in Soil by CRC ICPMS							
Aluminum (Al)	3210		50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Antimony (Sb)	0.17		0.10	mg/kg	06-NOV-18	14-NOV-18	R4333729
Arsenic (As)	1.46		0.10	mg/kg	06-NOV-18	14-NOV-18	R4333729
Barium (Ba)	200		0.50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Beryllium (Be)	0.18		0.10	mg/kg	06-NOV-18	14-NOV-18	R4333729
Boron (B)	<5.0		5.0	mg/kg	06-NOV-18	14-NOV-18	R4333729
Bismuth (Bi)	0.28		0.20	mg/kg	06-NOV-18	14-NOV-18	R4333729
Cadmium (Cd)	0.339		0.020	mg/kg	06-NOV-18	14-NOV-18	R4333729
Calcium (Ca)	7210		50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Chromium (Cr)	7.32		0.50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Cobalt (Co)	2.03		0.10	mg/kg	06-NOV-18	14-NOV-18	R4333729
Copper (Cu)	10.2		0.50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Iron (Fe)	3210		50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Lead (Pb)	3.87		0.50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Lithium (Li)	3.3		2.0	mg/kg	06-NOV-18	14-NOV-18	R4333729
Magnesium (Mg)	1980		20	mg/kg	06-NOV-18	14-NOV-18	R4333729
Manganese (Mn)	71.2		1.0	mg/kg	06-NOV-18	14-NOV-18	R4333729
Molybdenum (Mo)	4.09		0.10	mg/kg	06-NOV-18	14-NOV-18	R4333729
Nickel (Ni)	9.10		0.50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Phosphorus (P)	545		50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Potassium (K)	660		100	mg/kg	06-NOV-18	14-NOV-18	R4333729
Selenium (Se)	0.29		0.20	mg/kg	06-NOV-18	14-NOV-18	R4333729
Silver (Ag)	0.78		0.10	mg/kg	06-NOV-18	14-NOV-18	R4333729
Sodium (Na)	567		50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Strontium (Sr)	71.5		0.50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Sulfur (S)	1900		1000	mg/kg	06-NOV-18	14-NOV-18	R4333729
Thallium (Tl)	<0.050		0.050	mg/kg	06-NOV-18	14-NOV-18	R4333729
Tin (Sn)	<1.0		1.0	mg/kg	06-NOV-18	14-NOV-18	R4333729
Titanium (Ti)	11.4		1.0	mg/kg	06-NOV-18	14-NOV-18	R4333729

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2183989-5 NR18MS 77 OF (0-40)							
Sampled By: CLIENT on 14-OCT-18 @ 12:00							
Matrix: SOIL							
Metals in Soil by CRC ICPMS							
Tungsten (W)	13.3		0.50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Uranium (U)	30.9		0.050	mg/kg	06-NOV-18	14-NOV-18	R4333729
Vanadium (V)	5.86		0.20	mg/kg	06-NOV-18	14-NOV-18	R4333729
Zinc (Zn)	28.1		2.0	mg/kg	06-NOV-18	14-NOV-18	R4333729
Zirconium (Zr)	2.5		1.0	mg/kg	06-NOV-18	14-NOV-18	R4333729
Basic Salinity							
EC (Saturated Paste)							
Conductivity Sat. Paste	0.18		0.10	dS m-1	05-NOV-18	06-NOV-18	R4322487
SAR and Cations in saturated soil							
Calcium (Ca)	5.6		5.0	mg/L	06-NOV-18	06-NOV-18	R4322910
Potassium (K)	9.4		5.0	mg/L	06-NOV-18	06-NOV-18	R4322910
Magnesium (Mg)	<5.0		5.0	mg/L	06-NOV-18	06-NOV-18	R4322910
Sodium (Na)	22.3		5.0	mg/L	06-NOV-18	06-NOV-18	R4322910
SAR	2.60	SAR:M	0.10	SAR	06-NOV-18	06-NOV-18	R4322910
pH (1:2 Soil:CaCl2 Extraction)							
pH (1:2 CaCl2)	3.41		0.10	pH	06-NOV-18	06-NOV-18	R4321628
L2183989-6 NR18MS 77 OM (40-95)							
Sampled By: CLIENT on 14-OCT-18 @ 12:00							
Matrix: SOIL							
Miscellaneous Parameters							
Mercury (Hg)	0.0716		0.0050	mg/kg	06-NOV-18	06-NOV-18	R4322916
% Saturation	601		1.0	%	05-NOV-18	06-NOV-18	R4322487
Metals in Soil by CRC ICPMS							
Aluminum (Al)	2810		50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Antimony (Sb)	<0.10		0.10	mg/kg	06-NOV-18	14-NOV-18	R4333729
Arsenic (As)	0.61		0.10	mg/kg	06-NOV-18	14-NOV-18	R4333729
Barium (Ba)	266		0.50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Beryllium (Be)	0.18		0.10	mg/kg	06-NOV-18	14-NOV-18	R4333729
Boron (B)	<5.0		5.0	mg/kg	06-NOV-18	14-NOV-18	R4333729
Bismuth (Bi)	<0.20		0.20	mg/kg	06-NOV-18	14-NOV-18	R4333729
Cadmium (Cd)	0.275		0.020	mg/kg	06-NOV-18	14-NOV-18	R4333729
Calcium (Ca)	5910		50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Chromium (Cr)	4.50		0.50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Cobalt (Co)	0.79		0.10	mg/kg	06-NOV-18	14-NOV-18	R4333729
Copper (Cu)	3.95		0.50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Iron (Fe)	1490		50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Lead (Pb)	0.66		0.50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Lithium (Li)	<2.0		2.0	mg/kg	06-NOV-18	14-NOV-18	R4333729
Magnesium (Mg)	955		20	mg/kg	06-NOV-18	14-NOV-18	R4333729
Manganese (Mn)	20.2		1.0	mg/kg	06-NOV-18	14-NOV-18	R4333729
Molybdenum (Mo)	0.56		0.10	mg/kg	06-NOV-18	14-NOV-18	R4333729
Nickel (Ni)	5.90		0.50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Phosphorus (P)	504		50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Potassium (K)	160		100	mg/kg	06-NOV-18	14-NOV-18	R4333729
Selenium (Se)	0.33		0.20	mg/kg	06-NOV-18	14-NOV-18	R4333729
Silver (Ag)	0.12		0.10	mg/kg	06-NOV-18	14-NOV-18	R4333729
Sodium (Na)	154		50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Strontium (Sr)	52.6		0.50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Sulfur (S)	2400		1000	mg/kg	06-NOV-18	14-NOV-18	R4333729
Thallium (Tl)	<0.050		0.050	mg/kg	06-NOV-18	14-NOV-18	R4333729
Tin (Sn)	<1.0		1.0	mg/kg	06-NOV-18	14-NOV-18	R4333729

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

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Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2183989-6 NR18MS 77 OM (40-95)							
Sampled By: CLIENT on 14-OCT-18 @ 12:00							
Matrix: SOIL							
Metals in Soil by CRC ICPMS							
Titanium (Ti)	20.9		1.0	mg/kg	06-NOV-18	14-NOV-18	R4333729
Tungsten (W)	<0.50		0.50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Uranium (U)	0.794		0.050	mg/kg	06-NOV-18	14-NOV-18	R4333729
Vanadium (V)	4.37		0.20	mg/kg	06-NOV-18	14-NOV-18	R4333729
Zinc (Zn)	20.9		2.0	mg/kg	06-NOV-18	14-NOV-18	R4333729
Zirconium (Zr)	<1.0		1.0	mg/kg	06-NOV-18	14-NOV-18	R4333729
Basic Salinity							
EC (Saturated Paste)							
Conductivity Sat. Paste	0.15		0.10	dS m-1	05-NOV-18	06-NOV-18	R4322487
SAR and Cations in saturated soil							
Calcium (Ca)	10.3		5.0	mg/L	06-NOV-18	06-NOV-18	R4322910
Potassium (K)	<5.0		5.0	mg/L	06-NOV-18	06-NOV-18	R4322910
Magnesium (Mg)	<5.0		5.0	mg/L	06-NOV-18	06-NOV-18	R4322910
Sodium (Na)	9.7		5.0	mg/L	06-NOV-18	06-NOV-18	R4322910
SAR	0.83	SAR:M	0.10	SAR	06-NOV-18	06-NOV-18	R4322910
pH (1:2 Soil:CaCl2 Extraction)							
pH (1:2 CaCl2)	3.17		0.10	pH	06-NOV-18	06-NOV-18	R4321628
L2183989-7 NR18MS 58 AC (0-13)							
Sampled By: CLIENT on 13-OCT-18 @ 12:00							
Matrix: SOIL							
Miscellaneous Parameters							
Cation Exchange Capacity	<0.80		0.80	meq/100g	08-NOV-18	08-NOV-18	R4326328
Mercury (Hg)	<0.0050		0.0050	mg/kg	06-NOV-18	06-NOV-18	R4322916
% Saturation	25.9		1.0	%	05-NOV-18	06-NOV-18	R4322487
Particle Size Analysis:Mini-Pipet Method							
% Sand (2.0mm - 0.05mm)	94.0		1.0	%	05-NOV-18	06-NOV-18	R4322698
% Silt (0.05mm - 2um)	5.8		1.0	%	05-NOV-18	06-NOV-18	R4322698
% Clay (<2um)	<1.0		1.0	%	05-NOV-18	06-NOV-18	R4322698
Texture	Sand				05-NOV-18	06-NOV-18	R4322698
Metals in Soil by CRC ICPMS							
Aluminum (Al)	187		50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Antimony (Sb)	<0.10		0.10	mg/kg	06-NOV-18	14-NOV-18	R4333729
Arsenic (As)	0.20		0.10	mg/kg	06-NOV-18	14-NOV-18	R4333729
Barium (Ba)	6.98		0.50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Beryllium (Be)	<0.10		0.10	mg/kg	06-NOV-18	14-NOV-18	R4333729
Boron (B)	<5.0		5.0	mg/kg	06-NOV-18	14-NOV-18	R4333729
Bismuth (Bi)	<0.20		0.20	mg/kg	06-NOV-18	14-NOV-18	R4333729
Cadmium (Cd)	<0.020		0.020	mg/kg	06-NOV-18	14-NOV-18	R4333729
Calcium (Ca)	<50		50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Chromium (Cr)	<0.50		0.50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Cobalt (Co)	<0.10		0.10	mg/kg	06-NOV-18	14-NOV-18	R4333729
Copper (Cu)	<0.50		0.50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Iron (Fe)	250		50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Lead (Pb)	<0.50		0.50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Lithium (Li)	<2.0		2.0	mg/kg	06-NOV-18	14-NOV-18	R4333729
Magnesium (Mg)	54		20	mg/kg	06-NOV-18	14-NOV-18	R4333729
Manganese (Mn)	3.7		1.0	mg/kg	06-NOV-18	14-NOV-18	R4333729
Molybdenum (Mo)	<0.10		0.10	mg/kg	06-NOV-18	14-NOV-18	R4333729
Nickel (Ni)	<0.50		0.50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Phosphorus (P)	<50		50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Potassium (K)	<100		100	mg/kg	06-NOV-18	14-NOV-18	R4333729

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2183989-7 NR18MS 58 AC (0-13)							
Sampled By: CLIENT on 13-OCT-18 @ 12:00							
Matrix: SOIL							
Metals in Soil by CRC ICPMS							
Selenium (Se)	<0.20		0.20	mg/kg	06-NOV-18	14-NOV-18	R4333729
Silver (Ag)	<0.10		0.10	mg/kg	06-NOV-18	14-NOV-18	R4333729
Sodium (Na)	<50		50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Strontium (Sr)	1.75		0.50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Sulfur (S)	<1000		1000	mg/kg	06-NOV-18	14-NOV-18	R4333729
Thallium (Tl)	<0.050		0.050	mg/kg	06-NOV-18	14-NOV-18	R4333729
Tin (Sn)	<1.0		1.0	mg/kg	06-NOV-18	14-NOV-18	R4333729
Titanium (Ti)	25.5		1.0	mg/kg	06-NOV-18	14-NOV-18	R4333729
Tungsten (W)	0.62		0.50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Uranium (U)	<0.050		0.050	mg/kg	06-NOV-18	14-NOV-18	R4333729
Vanadium (V)	0.68		0.20	mg/kg	06-NOV-18	14-NOV-18	R4333729
Zinc (Zn)	<2.0		2.0	mg/kg	06-NOV-18	14-NOV-18	R4333729
Zirconium (Zr)	<1.0		1.0	mg/kg	06-NOV-18	14-NOV-18	R4333729
Basic Salinity							
EC (Saturated Paste)							
Conductivity Sat. Paste	<0.10		0.10	dS m-1	05-NOV-18	06-NOV-18	R4322487
SAR and Cations in saturated soil							
Calcium (Ca)	<5.0		5.0	mg/L	06-NOV-18	06-NOV-18	R4322910
Potassium (K)	5.6		5.0	mg/L	06-NOV-18	06-NOV-18	R4322910
Magnesium (Mg)	<5.0		5.0	mg/L	06-NOV-18	06-NOV-18	R4322910
Sodium (Na)	<5.0		5.0	mg/L	06-NOV-18	06-NOV-18	R4322910
SAR	Incalculable	SAR:INC	0.10	SAR	06-NOV-18	06-NOV-18	R4322910
pH (1:2 Soil:CaCl2 Extraction)							
pH (1:2 CaCl2)	4.13		0.10	pH	06-NOV-18	06-NOV-18	R4321628
L2183989-8 NR18MS 58 BM (13-34)							
Sampled By: CLIENT on 13-OCT-18 @ 12:00							
Matrix: SOIL							
Miscellaneous Parameters							
Mercury (Hg)	0.0232		0.0050	mg/kg	06-NOV-18	06-NOV-18	R4322916
% Saturation	28.0		1.0	%	05-NOV-18	06-NOV-18	R4322487
Particle Size Analysis:Mini-Pipet Method							
% Sand (2.0mm - 0.05mm)	83.7		1.0	%	05-NOV-18	06-NOV-18	R4322698
% Silt (0.05mm - 2um)	15.9		1.0	%	05-NOV-18	06-NOV-18	R4322698
% Clay (<2um)	<1.0		1.0	%	05-NOV-18	06-NOV-18	R4322698
Texture	Loamy sand				05-NOV-18	06-NOV-18	R4322698
Metals in Soil by CRC ICPMS							
Aluminum (Al)	4560		50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Antimony (Sb)	<0.10		0.10	mg/kg	06-NOV-18	14-NOV-18	R4333729
Arsenic (As)	0.64		0.10	mg/kg	06-NOV-18	14-NOV-18	R4333729
Barium (Ba)	10.2		0.50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Beryllium (Be)	<0.10		0.10	mg/kg	06-NOV-18	14-NOV-18	R4333729
Boron (B)	<5.0		5.0	mg/kg	06-NOV-18	14-NOV-18	R4333729
Bismuth (Bi)	<0.20		0.20	mg/kg	06-NOV-18	14-NOV-18	R4333729
Cadmium (Cd)	<0.020		0.020	mg/kg	06-NOV-18	14-NOV-18	R4333729
Calcium (Ca)	64		50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Chromium (Cr)	3.62		0.50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Cobalt (Co)	0.38		0.10	mg/kg	06-NOV-18	14-NOV-18	R4333729
Copper (Cu)	2.98		0.50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Iron (Fe)	3830		50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Lead (Pb)	1.97		0.50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Lithium (Li)	3.2		2.0	mg/kg	06-NOV-18	14-NOV-18	R4333729

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

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Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2183989-8 NR18MS 58 BM (13-34)							
Sampled By: CLIENT on 13-OCT-18 @ 12:00							
Matrix: SOIL							
Metals in Soil by CRC ICPMS							
Magnesium (Mg)	179		20	mg/kg	06-NOV-18	14-NOV-18	R4333729
Manganese (Mn)	10.5		1.0	mg/kg	06-NOV-18	14-NOV-18	R4333729
Molybdenum (Mo)	0.15		0.10	mg/kg	06-NOV-18	14-NOV-18	R4333729
Nickel (Ni)	1.06		0.50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Phosphorus (P)	373		50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Potassium (K)	<100		100	mg/kg	06-NOV-18	14-NOV-18	R4333729
Selenium (Se)	<0.20		0.20	mg/kg	06-NOV-18	14-NOV-18	R4333729
Silver (Ag)	<0.10		0.10	mg/kg	06-NOV-18	14-NOV-18	R4333729
Sodium (Na)	<50		50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Strontium (Sr)	4.10		0.50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Sulfur (S)	<1000		1000	mg/kg	06-NOV-18	14-NOV-18	R4333729
Thallium (Tl)	<0.050		0.050	mg/kg	06-NOV-18	14-NOV-18	R4333729
Tin (Sn)	<1.0		1.0	mg/kg	06-NOV-18	14-NOV-18	R4333729
Titanium (Ti)	78.0		1.0	mg/kg	06-NOV-18	14-NOV-18	R4333729
Tungsten (W)	<0.50		0.50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Uranium (U)	0.158		0.050	mg/kg	06-NOV-18	14-NOV-18	R4333729
Vanadium (V)	8.52		0.20	mg/kg	06-NOV-18	14-NOV-18	R4333729
Zinc (Zn)	16.8		2.0	mg/kg	06-NOV-18	14-NOV-18	R4333729
Zirconium (Zr)	1.7		1.0	mg/kg	06-NOV-18	14-NOV-18	R4333729
Basic Salinity							
EC (Saturated Paste)							
Conductivity Sat. Paste	0.10		0.10	dS m-1	05-NOV-18	06-NOV-18	R4322487
SAR and Cations in saturated soil							
Calcium (Ca)	<5.0		5.0	mg/L	06-NOV-18	06-NOV-18	R4322910
Potassium (K)	<5.0		5.0	mg/L	06-NOV-18	06-NOV-18	R4322910
Magnesium (Mg)	<5.0		5.0	mg/L	06-NOV-18	06-NOV-18	R4322910
Sodium (Na)	14.5		5.0	mg/L	06-NOV-18	06-NOV-18	R4322910
SAR	Incalculable	SAR:INC	0.10	SAR	06-NOV-18	06-NOV-18	R4322910
pH (1:2 Soil:CaCl2 Extraction)							
pH (1:2 CaCl2)	4.56		0.10	pH	06-NOV-18	06-NOV-18	R4321628
L2183989-9 NR18MS 58 C (34-100)							
Sampled By: CLIENT on 13-OCT-18 @ 12:00							
Matrix: SOIL							
Miscellaneous Parameters							
Mercury (Hg)	<0.0050		0.0050	mg/kg	06-NOV-18	06-NOV-18	R4322916
% Saturation	25.3		1.0	%	05-NOV-18	06-NOV-18	R4322487
Particle Size Analysis:Mini-Pipet Method							
% Sand (2.0mm - 0.05mm)	96.3		1.0	%	05-NOV-18	06-NOV-18	R4322698
% Silt (0.05mm - 2um)	3.6		1.0	%	05-NOV-18	06-NOV-18	R4322698
% Clay (<2um)	<1.0		1.0	%	05-NOV-18	06-NOV-18	R4322698
Texture	Sand				05-NOV-18	06-NOV-18	R4322698
Metals in Soil by CRC ICPMS							
Aluminum (Al)	782		50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Antimony (Sb)	<0.10		0.10	mg/kg	06-NOV-18	14-NOV-18	R4333729
Arsenic (As)	0.41		0.10	mg/kg	06-NOV-18	14-NOV-18	R4333729
Barium (Ba)	3.82		0.50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Beryllium (Be)	<0.10		0.10	mg/kg	06-NOV-18	14-NOV-18	R4333729
Boron (B)	<5.0		5.0	mg/kg	06-NOV-18	14-NOV-18	R4333729
Bismuth (Bi)	<0.20		0.20	mg/kg	06-NOV-18	14-NOV-18	R4333729
Cadmium (Cd)	<0.020		0.020	mg/kg	06-NOV-18	14-NOV-18	R4333729
Calcium (Ca)	<50		50	mg/kg	06-NOV-18	14-NOV-18	R4333729

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

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Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2183989-9 NR18MS 58 C (34-100)							
Sampled By: CLIENT on 13-OCT-18 @ 12:00							
Matrix: SOIL							
Metals in Soil by CRC ICPMS							
Chromium (Cr)	1.02		0.50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Cobalt (Co)	0.30		0.10	mg/kg	06-NOV-18	14-NOV-18	R4333729
Copper (Cu)	<0.50		0.50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Iron (Fe)	1020		50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Lead (Pb)	0.59		0.50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Lithium (Li)	<2.0		2.0	mg/kg	06-NOV-18	14-NOV-18	R4333729
Magnesium (Mg)	98		20	mg/kg	06-NOV-18	14-NOV-18	R4333729
Manganese (Mn)	7.1		1.0	mg/kg	06-NOV-18	14-NOV-18	R4333729
Molybdenum (Mo)	<0.10		0.10	mg/kg	06-NOV-18	14-NOV-18	R4333729
Nickel (Ni)	0.62		0.50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Phosphorus (P)	<50		50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Potassium (K)	<100		100	mg/kg	06-NOV-18	14-NOV-18	R4333729
Selenium (Se)	<0.20		0.20	mg/kg	06-NOV-18	14-NOV-18	R4333729
Silver (Ag)	<0.10		0.10	mg/kg	06-NOV-18	14-NOV-18	R4333729
Sodium (Na)	<50		50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Strontium (Sr)	3.88		0.50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Sulfur (S)	<1000		1000	mg/kg	06-NOV-18	14-NOV-18	R4333729
Thallium (Tl)	<0.050		0.050	mg/kg	06-NOV-18	14-NOV-18	R4333729
Tin (Sn)	<1.0		1.0	mg/kg	06-NOV-18	14-NOV-18	R4333729
Titanium (Ti)	29.5		1.0	mg/kg	06-NOV-18	14-NOV-18	R4333729
Tungsten (W)	<0.50		0.50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Uranium (U)	0.086		0.050	mg/kg	06-NOV-18	14-NOV-18	R4333729
Vanadium (V)	1.92		0.20	mg/kg	06-NOV-18	14-NOV-18	R4333729
Zinc (Zn)	2.1		2.0	mg/kg	06-NOV-18	14-NOV-18	R4333729
Zirconium (Zr)	1.0		1.0	mg/kg	06-NOV-18	14-NOV-18	R4333729
Basic Salinity							
EC (Saturated Paste)							
Conductivity Sat. Paste	<0.10		0.10	dS m-1	05-NOV-18	06-NOV-18	R4322487
SAR and Cations in saturated soil							
Calcium (Ca)	<5.0		5.0	mg/L	06-NOV-18	06-NOV-18	R4322910
Potassium (K)	<5.0		5.0	mg/L	06-NOV-18	06-NOV-18	R4322910
Magnesium (Mg)	<5.0		5.0	mg/L	06-NOV-18	06-NOV-18	R4322910
Sodium (Na)	<5.0		5.0	mg/L	06-NOV-18	06-NOV-18	R4322910
SAR	Incalculable	SAR:INC	0.10	SAR	06-NOV-18	06-NOV-18	R4322910
pH (1:2 Soil:CaCl2 Extraction)							
pH (1:2 CaCl2)	5.20		0.10	pH	06-NOV-18	06-NOV-18	R4321628
L2183989-10 NR18MS 82 AC (0-7)							
Sampled By: CLIENT on 14-OCT-18 @ 12:00							
Matrix: SOIL							
Miscellaneous Parameters							
Cation Exchange Capacity	<0.80		0.80	meq/100g	08-NOV-18	08-NOV-18	R4326328
Mercury (Hg)	<0.0050		0.0050	mg/kg	06-NOV-18	06-NOV-18	R4322916
% Saturation	24.8		1.0	%	05-NOV-18	06-NOV-18	R4322487
Particle Size Analysis:Mini-Pipet Method							
% Sand (2.0mm - 0.05mm)	91.0		1.0	%	05-NOV-18	06-NOV-18	R4322698
% Silt (0.05mm - 2um)	8.9		1.0	%	05-NOV-18	06-NOV-18	R4322698
% Clay (<2um)	<1.0		1.0	%	05-NOV-18	06-NOV-18	R4322698
Texture	Sand				05-NOV-18	06-NOV-18	R4322698
Metals in Soil by CRC ICPMS							
Aluminum (Al)	354		50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Antimony (Sb)	<0.10		0.10	mg/kg	06-NOV-18	14-NOV-18	R4333729

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2183989-10 NR18MS 82 AC (0-7)							
Sampled By: CLIENT on 14-OCT-18 @ 12:00							
Matrix: SOIL							
Metals in Soil by CRC ICPMS							
Arsenic (As)	0.22		0.10	mg/kg	06-NOV-18	14-NOV-18	R4333729
Barium (Ba)	3.75		0.50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Beryllium (Be)	<0.10		0.10	mg/kg	06-NOV-18	14-NOV-18	R4333729
Boron (B)	<5.0		5.0	mg/kg	06-NOV-18	14-NOV-18	R4333729
Bismuth (Bi)	<0.20		0.20	mg/kg	06-NOV-18	14-NOV-18	R4333729
Cadmium (Cd)	<0.020		0.020	mg/kg	06-NOV-18	14-NOV-18	R4333729
Calcium (Ca)	58		50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Chromium (Cr)	0.51		0.50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Cobalt (Co)	<0.10		0.10	mg/kg	06-NOV-18	14-NOV-18	R4333729
Copper (Cu)	<0.50		0.50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Iron (Fe)	491		50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Lead (Pb)	0.67		0.50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Lithium (Li)	<2.0		2.0	mg/kg	06-NOV-18	14-NOV-18	R4333729
Magnesium (Mg)	31		20	mg/kg	06-NOV-18	14-NOV-18	R4333729
Manganese (Mn)	14.7		1.0	mg/kg	06-NOV-18	14-NOV-18	R4333729
Molybdenum (Mo)	<0.10		0.10	mg/kg	06-NOV-18	14-NOV-18	R4333729
Nickel (Ni)	<0.50		0.50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Phosphorus (P)	<50		50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Potassium (K)	<100		100	mg/kg	06-NOV-18	14-NOV-18	R4333729
Selenium (Se)	<0.20		0.20	mg/kg	06-NOV-18	14-NOV-18	R4333729
Silver (Ag)	<0.10		0.10	mg/kg	06-NOV-18	14-NOV-18	R4333729
Sodium (Na)	<50		50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Strontium (Sr)	1.78		0.50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Sulfur (S)	<1000		1000	mg/kg	06-NOV-18	14-NOV-18	R4333729
Thallium (Tl)	<0.050		0.050	mg/kg	06-NOV-18	14-NOV-18	R4333729
Tin (Sn)	<1.0		1.0	mg/kg	06-NOV-18	14-NOV-18	R4333729
Titanium (Ti)	25.9		1.0	mg/kg	06-NOV-18	14-NOV-18	R4333729
Tungsten (W)	<0.50		0.50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Uranium (U)	<0.050		0.050	mg/kg	06-NOV-18	14-NOV-18	R4333729
Vanadium (V)	1.28		0.20	mg/kg	06-NOV-18	14-NOV-18	R4333729
Zinc (Zn)	<2.0		2.0	mg/kg	06-NOV-18	14-NOV-18	R4333729
Zirconium (Zr)	<1.0		1.0	mg/kg	06-NOV-18	14-NOV-18	R4333729
Basic Salinity							
EC (Saturated Paste)							
Conductivity Sat. Paste	<0.10		0.10	dS m-1	05-NOV-18	06-NOV-18	R4322487
SAR and Cations in saturated soil							
Calcium (Ca)	7.3		5.0	mg/L	06-NOV-18	06-NOV-18	R4322910
Potassium (K)	<5.0		5.0	mg/L	06-NOV-18	06-NOV-18	R4322910
Magnesium (Mg)	<5.0		5.0	mg/L	06-NOV-18	06-NOV-18	R4322910
Sodium (Na)	<5.0		5.0	mg/L	06-NOV-18	06-NOV-18	R4322910
SAR	<0.50	SAR:DL	0.50	SAR	06-NOV-18	06-NOV-18	R4322910
pH (1:2 Soil:CaCl2 Extraction)							
pH (1:2 CaCl2)	4.09		0.10	pH	06-NOV-18	06-NOV-18	R4321628
L2183989-11 NR18MS 82 B+J (7-35)							
Sampled By: CLIENT on 14-OCT-18 @ 12:00							
Matrix: SOIL							
Miscellaneous Parameters							
Mercury (Hg)	0.0211		0.0050	mg/kg	06-NOV-18	06-NOV-18	R4322916
% Saturation	29.6		1.0	%	05-NOV-18	06-NOV-18	R4322487
Particle Size Analysis:Mini-Pipet Method							
% Sand (2.0mm - 0.05mm)	74.3		1.0	%	05-NOV-18	06-NOV-18	R4322698

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2183989-11 NR18MS 82 B+J (7-35)							
Sampled By: CLIENT on 14-OCT-18 @ 12:00							
Matrix: SOIL							
Particle Size Analysis:Mini-Pipet Method							
% Silt (0.05mm - 2um)	24.8		1.0	%	05-NOV-18	06-NOV-18	R4322698
% Clay (<2um)	<1.0		1.0	%	05-NOV-18	06-NOV-18	R4322698
Texture	Loamy sand				05-NOV-18	06-NOV-18	R4322698
Metals in Soil by CRC ICPMS							
Aluminum (Al)	4760		50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Antimony (Sb)	<0.10		0.10	mg/kg	06-NOV-18	14-NOV-18	R4333729
Arsenic (As)	0.82		0.10	mg/kg	06-NOV-18	14-NOV-18	R4333729
Barium (Ba)	12.0		0.50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Beryllium (Be)	0.11		0.10	mg/kg	06-NOV-18	14-NOV-18	R4333729
Boron (B)	<5.0		5.0	mg/kg	06-NOV-18	14-NOV-18	R4333729
Bismuth (Bi)	<0.20		0.20	mg/kg	06-NOV-18	14-NOV-18	R4333729
Cadmium (Cd)	<0.020		0.020	mg/kg	06-NOV-18	14-NOV-18	R4333729
Calcium (Ca)	92		50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Chromium (Cr)	3.95		0.50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Cobalt (Co)	0.57		0.10	mg/kg	06-NOV-18	14-NOV-18	R4333729
Copper (Cu)	1.91		0.50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Iron (Fe)	4140		50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Lead (Pb)	1.88		0.50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Lithium (Li)	4.3		2.0	mg/kg	06-NOV-18	14-NOV-18	R4333729
Magnesium (Mg)	266		20	mg/kg	06-NOV-18	14-NOV-18	R4333729
Manganese (Mn)	14.5		1.0	mg/kg	06-NOV-18	14-NOV-18	R4333729
Molybdenum (Mo)	0.12		0.10	mg/kg	06-NOV-18	14-NOV-18	R4333729
Nickel (Ni)	1.41		0.50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Phosphorus (P)	242		50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Potassium (K)	<100		100	mg/kg	06-NOV-18	14-NOV-18	R4333729
Selenium (Se)	<0.20		0.20	mg/kg	06-NOV-18	14-NOV-18	R4333729
Silver (Ag)	<0.10		0.10	mg/kg	06-NOV-18	14-NOV-18	R4333729
Sodium (Na)	<50		50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Strontium (Sr)	3.89		0.50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Sulfur (S)	<1000		1000	mg/kg	06-NOV-18	14-NOV-18	R4333729
Thallium (Tl)	<0.050		0.050	mg/kg	06-NOV-18	14-NOV-18	R4333729
Tin (Sn)	<1.0		1.0	mg/kg	06-NOV-18	14-NOV-18	R4333729
Titanium (Ti)	99.4		1.0	mg/kg	06-NOV-18	14-NOV-18	R4333729
Tungsten (W)	<0.50		0.50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Uranium (U)	0.214		0.050	mg/kg	06-NOV-18	14-NOV-18	R4333729
Vanadium (V)	8.42		0.20	mg/kg	06-NOV-18	14-NOV-18	R4333729
Zinc (Zn)	8.1		2.0	mg/kg	06-NOV-18	14-NOV-18	R4333729
Zirconium (Zr)	1.8		1.0	mg/kg	06-NOV-18	14-NOV-18	R4333729
Basic Salinity							
EC (Saturated Paste)							
Conductivity Sat. Paste	<0.10		0.10	dS m-1	05-NOV-18	06-NOV-18	R4322487
SAR and Cations in saturated soil							
Calcium (Ca)	<5.0		5.0	mg/L	06-NOV-18	06-NOV-18	R4322910
Potassium (K)	<5.0		5.0	mg/L	06-NOV-18	06-NOV-18	R4322910
Magnesium (Mg)	<5.0		5.0	mg/L	06-NOV-18	06-NOV-18	R4322910
Sodium (Na)	<5.0		5.0	mg/L	06-NOV-18	06-NOV-18	R4322910
SAR	Incalculable	SAR:INC	0.10	SAR	06-NOV-18	06-NOV-18	R4322910
pH (1:2 Soil:CaCl2 Extraction)							
pH (1:2 CaCl2)	4.54		0.10	pH	06-NOV-18	06-NOV-18	R4321628

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2183989-12 NR18MS 96 LFH (9-0)							
Sampled By: CLIENT on 15-OCT-18 @ 12:00							
Matrix: SOIL							
Miscellaneous Parameters							
Mercury (Hg)	0.0853		0.0050	mg/kg	06-NOV-18	06-NOV-18	R4322916
% Saturation	428		1.0	%	05-NOV-18	06-NOV-18	R4322487
Metals in Soil by CRC ICPMS							
Aluminum (Al)	4140		50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Antimony (Sb)	<0.10		0.10	mg/kg	06-NOV-18	14-NOV-18	R4333729
Arsenic (As)	1.08		0.10	mg/kg	06-NOV-18	14-NOV-18	R4333729
Barium (Ba)	235		0.50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Beryllium (Be)	0.31		0.10	mg/kg	06-NOV-18	14-NOV-18	R4333729
Boron (B)	<5.0		5.0	mg/kg	06-NOV-18	14-NOV-18	R4333729
Bismuth (Bi)	<0.20		0.20	mg/kg	06-NOV-18	14-NOV-18	R4333729
Cadmium (Cd)	0.257		0.020	mg/kg	06-NOV-18	14-NOV-18	R4333729
Calcium (Ca)	2870		50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Chromium (Cr)	3.40		0.50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Cobalt (Co)	0.70		0.10	mg/kg	06-NOV-18	14-NOV-18	R4333729
Copper (Cu)	6.82		0.50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Iron (Fe)	2420		50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Lead (Pb)	6.43		0.50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Lithium (Li)	<2.0		2.0	mg/kg	06-NOV-18	14-NOV-18	R4333729
Magnesium (Mg)	324		20	mg/kg	06-NOV-18	14-NOV-18	R4333729
Manganese (Mn)	33.6		1.0	mg/kg	06-NOV-18	14-NOV-18	R4333729
Molybdenum (Mo)	0.34		0.10	mg/kg	06-NOV-18	14-NOV-18	R4333729
Nickel (Ni)	4.39		0.50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Phosphorus (P)	814		50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Potassium (K)	400		100	mg/kg	06-NOV-18	14-NOV-18	R4333729
Selenium (Se)	0.38		0.20	mg/kg	06-NOV-18	14-NOV-18	R4333729
Silver (Ag)	<0.10		0.10	mg/kg	06-NOV-18	14-NOV-18	R4333729
Sodium (Na)	<50		50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Strontium (Sr)	33.2		0.50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Sulfur (S)	<1000		1000	mg/kg	06-NOV-18	14-NOV-18	R4333729
Thallium (Tl)	<0.050		0.050	mg/kg	06-NOV-18	14-NOV-18	R4333729
Tin (Sn)	<1.0		1.0	mg/kg	06-NOV-18	14-NOV-18	R4333729
Titanium (Ti)	18.0		1.0	mg/kg	06-NOV-18	14-NOV-18	R4333729
Tungsten (W)	<0.50		0.50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Uranium (U)	0.181		0.050	mg/kg	06-NOV-18	14-NOV-18	R4333729
Vanadium (V)	4.32		0.20	mg/kg	06-NOV-18	14-NOV-18	R4333729
Zinc (Zn)	10.6		2.0	mg/kg	06-NOV-18	14-NOV-18	R4333729
Zirconium (Zr)	<1.0		1.0	mg/kg	06-NOV-18	14-NOV-18	R4333729
Basic Salinity							
EC (Saturated Paste)							
Conductivity Sat. Paste	0.20		0.10	dS m-1	05-NOV-18	06-NOV-18	R4322487
SAR and Cations in saturated soil							
Calcium (Ca)	10.2		5.0	mg/L	06-NOV-18	06-NOV-18	R4322910
Potassium (K)	12.2		5.0	mg/L	06-NOV-18	06-NOV-18	R4322910
Magnesium (Mg)	<5.0		5.0	mg/L	06-NOV-18	06-NOV-18	R4322910
Sodium (Na)	<5.0		5.0	mg/L	06-NOV-18	06-NOV-18	R4322910
SAR	<0.40	SAR:DL	0.40	SAR	06-NOV-18	06-NOV-18	R4322910
pH (1:2 Soil:CaCl2 Extraction)							
pH (1:2 CaCl2)	2.86		0.10	pH	06-NOV-18	06-NOV-18	R4321628
L2183989-13 NR18MS 96 AHC (0-5)							
Sampled By: CLIENT on 15-OCT-18 @ 12:00							
Matrix: SOIL							

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2183989-13 NR18MS 96 AHC (0-5)							
Sampled By: CLIENT on 15-OCT-18 @ 12:00							
Matrix: SOIL							
Miscellaneous Parameters							
Cation Exchange Capacity	7.68		0.80	meq/100g	08-NOV-18	08-NOV-18	R4326328
Mercury (Hg)	0.0126		0.0050	mg/kg	06-NOV-18	06-NOV-18	R4322916
% Saturation	56.7		1.0	%	05-NOV-18	06-NOV-18	R4322487
Particle Size Analysis:Mini-Pipet Method							
% Sand (2.0mm - 0.05mm)	27.9		1.0	%	05-NOV-18	06-NOV-18	R4322698
% Silt (0.05mm - 2um)	69.6		1.0	%	05-NOV-18	06-NOV-18	R4322698
% Clay (<2um)	2.5		1.0	%	05-NOV-18	06-NOV-18	R4322698
Texture	Silt loam				05-NOV-18	06-NOV-18	R4322698
Metals in Soil by CRC ICPMS							
Aluminum (Al)	1980		50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Antimony (Sb)	<0.10		0.10	mg/kg	06-NOV-18	14-NOV-18	R4333729
Arsenic (As)	0.52		0.10	mg/kg	06-NOV-18	14-NOV-18	R4333729
Barium (Ba)	17.3		0.50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Beryllium (Be)	<0.10		0.10	mg/kg	06-NOV-18	14-NOV-18	R4333729
Boron (B)	<5.0		5.0	mg/kg	06-NOV-18	14-NOV-18	R4333729
Bismuth (Bi)	<0.20		0.20	mg/kg	06-NOV-18	14-NOV-18	R4333729
Cadmium (Cd)	<0.020		0.020	mg/kg	06-NOV-18	14-NOV-18	R4333729
Calcium (Ca)	83		50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Chromium (Cr)	2.93		0.50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Cobalt (Co)	0.16		0.10	mg/kg	06-NOV-18	14-NOV-18	R4333729
Copper (Cu)	0.91		0.50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Iron (Fe)	1750		50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Lead (Pb)	2.14		0.50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Lithium (Li)	<2.0		2.0	mg/kg	06-NOV-18	14-NOV-18	R4333729
Magnesium (Mg)	136		20	mg/kg	06-NOV-18	14-NOV-18	R4333729
Manganese (Mn)	6.2		1.0	mg/kg	06-NOV-18	14-NOV-18	R4333729
Molybdenum (Mo)	<0.10		0.10	mg/kg	06-NOV-18	14-NOV-18	R4333729
Nickel (Ni)	0.61		0.50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Phosphorus (P)	109		50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Potassium (K)	<100		100	mg/kg	06-NOV-18	14-NOV-18	R4333729
Selenium (Se)	<0.20		0.20	mg/kg	06-NOV-18	14-NOV-18	R4333729
Silver (Ag)	<0.10		0.10	mg/kg	06-NOV-18	14-NOV-18	R4333729
Sodium (Na)	<50		50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Strontium (Sr)	2.84		0.50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Sulfur (S)	<1000		1000	mg/kg	06-NOV-18	14-NOV-18	R4333729
Thallium (Tl)	<0.050		0.050	mg/kg	06-NOV-18	14-NOV-18	R4333729
Tin (Sn)	<1.0		1.0	mg/kg	06-NOV-18	14-NOV-18	R4333729
Titanium (Ti)	13.8		1.0	mg/kg	06-NOV-18	14-NOV-18	R4333729
Tungsten (W)	<0.50		0.50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Uranium (U)	0.180		0.050	mg/kg	06-NOV-18	14-NOV-18	R4333729
Vanadium (V)	4.31		0.20	mg/kg	06-NOV-18	14-NOV-18	R4333729
Zinc (Zn)	2.6		2.0	mg/kg	06-NOV-18	14-NOV-18	R4333729
Zirconium (Zr)	<1.0		1.0	mg/kg	06-NOV-18	14-NOV-18	R4333729
Basic Salinity							
EC (Saturated Paste)							
Conductivity Sat. Paste	0.17		0.10	dS m-1	05-NOV-18	06-NOV-18	R4322487
SAR and Cations in saturated soil							
Calcium (Ca)	5.9		5.0	mg/L	06-NOV-18	06-NOV-18	R4322910
Potassium (K)	8.1		5.0	mg/L	06-NOV-18	06-NOV-18	R4322910
Magnesium (Mg)	<5.0		5.0	mg/L	06-NOV-18	06-NOV-18	R4322910
Sodium (Na)	5.6		5.0	mg/L	06-NOV-18	06-NOV-18	R4322910

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2183989-13 NR18MS 96 AHC (0-5)							
Sampled By: CLIENT on 15-OCT-18 @ 12:00							
Matrix: SOIL							
SAR and Cations in saturated soil							
SAR	0.64	SAR:M	0.10	SAR	06-NOV-18	06-NOV-18	R4322910
pH (1:2 Soil:CaCl2 Extraction)							
pH (1:2 CaCl2)	3.20		0.10	pH	06-NOV-18	06-NOV-18	R4321628
L2183989-14 NR18MS 96 BMGJ (5-24)							
Sampled By: CLIENT on 15-OCT-18 @ 12:00							
Matrix: SOIL							
Miscellaneous Parameters							
Mercury (Hg)	0.0124		0.0050	mg/kg	06-NOV-18	06-NOV-18	R4322916
% Saturation	41.2		1.0	%	05-NOV-18	06-NOV-18	R4322487
Particle Size Analysis:Mini-Pipet Method							
% Sand (2.0mm - 0.05mm)	26.3		1.0	%	05-NOV-18	06-NOV-18	R4322698
% Silt (0.05mm - 2um)	71.6		1.0	%	05-NOV-18	06-NOV-18	R4322698
% Clay (<2um)	2.1		1.0	%	05-NOV-18	06-NOV-18	R4322698
Texture	Silt loam				05-NOV-18	06-NOV-18	R4322698
Metals in Soil by CRC ICPMS							
Aluminum (Al)	7180		50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Antimony (Sb)	<0.10		0.10	mg/kg	06-NOV-18	14-NOV-18	R4333729
Arsenic (As)	0.97		0.10	mg/kg	06-NOV-18	14-NOV-18	R4333729
Barium (Ba)	22.3		0.50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Beryllium (Be)	0.16		0.10	mg/kg	06-NOV-18	14-NOV-18	R4333729
Boron (B)	<5.0		5.0	mg/kg	06-NOV-18	14-NOV-18	R4333729
Bismuth (Bi)	<0.20		0.20	mg/kg	06-NOV-18	14-NOV-18	R4333729
Cadmium (Cd)	<0.020		0.020	mg/kg	06-NOV-18	14-NOV-18	R4333729
Calcium (Ca)	161		50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Chromium (Cr)	7.60		0.50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Cobalt (Co)	1.00		0.10	mg/kg	06-NOV-18	14-NOV-18	R4333729
Copper (Cu)	0.85		0.50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Iron (Fe)	6350		50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Lead (Pb)	2.44		0.50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Lithium (Li)	4.6		2.0	mg/kg	06-NOV-18	14-NOV-18	R4333729
Magnesium (Mg)	688		20	mg/kg	06-NOV-18	14-NOV-18	R4333729
Manganese (Mn)	20.3		1.0	mg/kg	06-NOV-18	14-NOV-18	R4333729
Molybdenum (Mo)	0.13		0.10	mg/kg	06-NOV-18	14-NOV-18	R4333729
Nickel (Ni)	2.18		0.50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Phosphorus (P)	145		50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Potassium (K)	120		100	mg/kg	06-NOV-18	14-NOV-18	R4333729
Selenium (Se)	<0.20		0.20	mg/kg	06-NOV-18	14-NOV-18	R4333729
Silver (Ag)	<0.10		0.10	mg/kg	06-NOV-18	14-NOV-18	R4333729
Sodium (Na)	<50		50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Strontium (Sr)	5.40		0.50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Sulfur (S)	<1000		1000	mg/kg	06-NOV-18	14-NOV-18	R4333729
Thallium (Tl)	<0.050		0.050	mg/kg	06-NOV-18	14-NOV-18	R4333729
Tin (Sn)	<1.0		1.0	mg/kg	06-NOV-18	14-NOV-18	R4333729
Titanium (Ti)	161		1.0	mg/kg	06-NOV-18	14-NOV-18	R4333729
Tungsten (W)	<0.50		0.50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Uranium (U)	0.348		0.050	mg/kg	06-NOV-18	14-NOV-18	R4333729
Vanadium (V)	11.9		0.20	mg/kg	06-NOV-18	14-NOV-18	R4333729
Zinc (Zn)	5.6		2.0	mg/kg	06-NOV-18	14-NOV-18	R4333729
Zirconium (Zr)	<1.0		1.0	mg/kg	06-NOV-18	14-NOV-18	R4333729
Basic Salinity							
EC (Saturated Paste)							

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2183989-14 NR18MS 96 BMGJ (5-24)							
Sampled By: CLIENT on 15-OCT-18 @ 12:00							
Matrix: SOIL							
EC (Saturated Paste)							
Conductivity Sat. Paste	<0.10		0.10	dS m-1	05-NOV-18	06-NOV-18	R4322487
SAR and Cations in saturated soil							
Calcium (Ca)	<5.0		5.0	mg/L	06-NOV-18	06-NOV-18	R4322910
Potassium (K)	<5.0		5.0	mg/L	06-NOV-18	06-NOV-18	R4322910
Magnesium (Mg)	<5.0		5.0	mg/L	06-NOV-18	06-NOV-18	R4322910
Sodium (Na)	<5.0		5.0	mg/L	06-NOV-18	06-NOV-18	R4322910
SAR	Incalculable	SAR:INC	0.10	SAR	06-NOV-18	06-NOV-18	R4322910
pH (1:2 Soil:CaCl2 Extraction)							
pH (1:2 CaCl2)	4.24		0.10	pH	06-NOV-18	06-NOV-18	R4321628
L2183989-15 NR18MS 96 BC (24-55)							
Sampled By: CLIENT on 15-OCT-18 @ 12:00							
Matrix: SOIL							
Miscellaneous Parameters							
Mercury (Hg)	0.0119		0.0050	mg/kg	06-NOV-18	06-NOV-18	R4322916
% Saturation	34.2		1.0	%	05-NOV-18	06-NOV-18	R4322487
Particle Size Analysis:Mini-Pipet Method							
% Sand (2.0mm - 0.05mm)	28.5		1.0	%	05-NOV-18	06-NOV-18	R4322698
% Silt (0.05mm - 2um)	67.7		1.0	%	05-NOV-18	06-NOV-18	R4322698
% Clay (<2um)	3.8		1.0	%	05-NOV-18	06-NOV-18	R4322698
Texture	Silt loam				05-NOV-18	06-NOV-18	R4322698
Metals in Soil by CRC ICPMS							
Aluminum (Al)	5460		50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Antimony (Sb)	<0.10		0.10	mg/kg	06-NOV-18	14-NOV-18	R4333729
Arsenic (As)	1.06		0.10	mg/kg	06-NOV-18	14-NOV-18	R4333729
Barium (Ba)	22.6		0.50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Beryllium (Be)	0.15		0.10	mg/kg	06-NOV-18	14-NOV-18	R4333729
Boron (B)	<5.0		5.0	mg/kg	06-NOV-18	14-NOV-18	R4333729
Bismuth (Bi)	<0.20		0.20	mg/kg	06-NOV-18	14-NOV-18	R4333729
Cadmium (Cd)	<0.020		0.020	mg/kg	06-NOV-18	14-NOV-18	R4333729
Calcium (Ca)	136		50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Chromium (Cr)	8.47		0.50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Cobalt (Co)	1.25		0.10	mg/kg	06-NOV-18	14-NOV-18	R4333729
Copper (Cu)	0.89		0.50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Iron (Fe)	5160		50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Lead (Pb)	1.85		0.50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Lithium (Li)	4.6		2.0	mg/kg	06-NOV-18	14-NOV-18	R4333729
Magnesium (Mg)	1010		20	mg/kg	06-NOV-18	14-NOV-18	R4333729
Manganese (Mn)	24.8		1.0	mg/kg	06-NOV-18	14-NOV-18	R4333729
Molybdenum (Mo)	0.16		0.10	mg/kg	06-NOV-18	14-NOV-18	R4333729
Nickel (Ni)	3.11		0.50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Phosphorus (P)	68		50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Potassium (K)	160		100	mg/kg	06-NOV-18	14-NOV-18	R4333729
Selenium (Se)	<0.20		0.20	mg/kg	06-NOV-18	14-NOV-18	R4333729
Silver (Ag)	<0.10		0.10	mg/kg	06-NOV-18	14-NOV-18	R4333729
Sodium (Na)	<50		50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Strontium (Sr)	7.95		0.50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Sulfur (S)	<1000		1000	mg/kg	06-NOV-18	14-NOV-18	R4333729
Thallium (Tl)	<0.050		0.050	mg/kg	06-NOV-18	14-NOV-18	R4333729
Tin (Sn)	<1.0		1.0	mg/kg	06-NOV-18	14-NOV-18	R4333729
Titanium (Ti)	197		1.0	mg/kg	06-NOV-18	14-NOV-18	R4333729
Tungsten (W)	<0.50		0.50	mg/kg	06-NOV-18	14-NOV-18	R4333729

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2183989-15 NR18MS 96 BC (24-55)							
Sampled By: CLIENT on 15-OCT-18 @ 12:00							
Matrix: SOIL							
Metals in Soil by CRC ICPMS							
Uranium (U)	0.397		0.050	mg/kg	06-NOV-18	14-NOV-18	R4333729
Vanadium (V)	11.9		0.20	mg/kg	06-NOV-18	14-NOV-18	R4333729
Zinc (Zn)	6.5		2.0	mg/kg	06-NOV-18	14-NOV-18	R4333729
Zirconium (Zr)	3.2		1.0	mg/kg	06-NOV-18	14-NOV-18	R4333729
Basic Salinity							
EC (Saturated Paste)							
Conductivity Sat. Paste	<0.10		0.10	dS m-1	05-NOV-18	06-NOV-18	R4322487
SAR and Cations in saturated soil							
Calcium (Ca)	<5.0		5.0	mg/L	06-NOV-18	06-NOV-18	R4322910
Potassium (K)	<5.0		5.0	mg/L	06-NOV-18	06-NOV-18	R4322910
Magnesium (Mg)	<5.0		5.0	mg/L	06-NOV-18	06-NOV-18	R4322910
Sodium (Na)	6.0		5.0	mg/L	06-NOV-18	06-NOV-18	R4322910
SAR	Incalculable	SAR:INC	0.10	SAR	06-NOV-18	06-NOV-18	R4322910
pH (1:2 Soil:CaCl2 Extraction)							
pH (1:2 CaCl2)	3.91		0.10	pH	06-NOV-18	06-NOV-18	R4321628
L2183989-16 NR18MS 96 C (55-100)							
Sampled By: CLIENT on 15-OCT-18 @ 12:00							
Matrix: SOIL							
Miscellaneous Parameters							
Mercury (Hg)	<0.0050		0.0050	mg/kg	06-NOV-18	06-NOV-18	R4322916
% Saturation	23.5		1.0	%	05-NOV-18	06-NOV-18	R4322487
Particle Size Analysis:Mini-Pipet Method							
% Sand (2.0mm - 0.05mm)	81.3		1.0	%	05-NOV-18	06-NOV-18	R4322698
% Silt (0.05mm - 2um)	17.9		1.0	%	05-NOV-18	06-NOV-18	R4322698
% Clay (<2um)	<1.0		1.0	%	05-NOV-18	06-NOV-18	R4322698
Texture	Loamy sand				05-NOV-18	06-NOV-18	R4322698
Metals in Soil by CRC ICPMS							
Aluminum (Al)	1870		50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Antimony (Sb)	<0.10		0.10	mg/kg	06-NOV-18	14-NOV-18	R4333729
Arsenic (As)	0.59		0.10	mg/kg	06-NOV-18	14-NOV-18	R4333729
Barium (Ba)	8.46		0.50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Beryllium (Be)	<0.10		0.10	mg/kg	06-NOV-18	14-NOV-18	R4333729
Boron (B)	<5.0		5.0	mg/kg	06-NOV-18	14-NOV-18	R4333729
Bismuth (Bi)	<0.20		0.20	mg/kg	06-NOV-18	14-NOV-18	R4333729
Cadmium (Cd)	<0.020		0.020	mg/kg	06-NOV-18	14-NOV-18	R4333729
Calcium (Ca)	104		50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Chromium (Cr)	2.81		0.50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Cobalt (Co)	0.58		0.10	mg/kg	06-NOV-18	14-NOV-18	R4333729
Copper (Cu)	0.57		0.50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Iron (Fe)	1860		50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Lead (Pb)	0.94		0.50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Lithium (Li)	<2.0		2.0	mg/kg	06-NOV-18	14-NOV-18	R4333729
Magnesium (Mg)	324		20	mg/kg	06-NOV-18	14-NOV-18	R4333729
Manganese (Mn)	19.7		1.0	mg/kg	06-NOV-18	14-NOV-18	R4333729
Molybdenum (Mo)	<0.10		0.10	mg/kg	06-NOV-18	14-NOV-18	R4333729
Nickel (Ni)	1.28		0.50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Phosphorus (P)	55		50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Potassium (K)	130		100	mg/kg	06-NOV-18	14-NOV-18	R4333729
Selenium (Se)	<0.20		0.20	mg/kg	06-NOV-18	14-NOV-18	R4333729
Silver (Ag)	<0.10		0.10	mg/kg	06-NOV-18	14-NOV-18	R4333729
Sodium (Na)	<50		50	mg/kg	06-NOV-18	14-NOV-18	R4333729

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2183989-16 NR18MS 96 C (55-100)							
Sampled By: CLIENT on 15-OCT-18 @ 12:00							
Matrix: SOIL							
Metals in Soil by CRC ICPMS							
Strontium (Sr)	6.47		0.50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Sulfur (S)	<1000		1000	mg/kg	06-NOV-18	14-NOV-18	R4333729
Thallium (Tl)	<0.050		0.050	mg/kg	06-NOV-18	14-NOV-18	R4333729
Tin (Sn)	<1.0		1.0	mg/kg	06-NOV-18	14-NOV-18	R4333729
Titanium (Ti)	60.9		1.0	mg/kg	06-NOV-18	14-NOV-18	R4333729
Tungsten (W)	<0.50		0.50	mg/kg	06-NOV-18	14-NOV-18	R4333729
Uranium (U)	0.157		0.050	mg/kg	06-NOV-18	14-NOV-18	R4333729
Vanadium (V)	4.45		0.20	mg/kg	06-NOV-18	14-NOV-18	R4333729
Zinc (Zn)	2.7		2.0	mg/kg	06-NOV-18	14-NOV-18	R4333729
Zirconium (Zr)	1.3		1.0	mg/kg	06-NOV-18	14-NOV-18	R4333729
Basic Salinity							
EC (Saturated Paste)							
Conductivity Sat. Paste	<0.10		0.10	dS m-1	05-NOV-18	06-NOV-18	R4322487
SAR and Cations in saturated soil							
Calcium (Ca)	<5.0		5.0	mg/L	06-NOV-18	06-NOV-18	R4322910
Potassium (K)	<5.0		5.0	mg/L	06-NOV-18	06-NOV-18	R4322910
Magnesium (Mg)	<5.0		5.0	mg/L	06-NOV-18	06-NOV-18	R4322910
Sodium (Na)	<5.0		5.0	mg/L	06-NOV-18	06-NOV-18	R4322910
SAR	Incalculable	SAR:INC	0.10	SAR	06-NOV-18	06-NOV-18	R4322910
pH (1:2 Soil:CaCl2 Extraction)							
pH (1:2 CaCl2)	4.33		0.10	pH	06-NOV-18	06-NOV-18	R4321628

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

Reference Information

Sample Parameter Qualifier Key:

Qualifier	Description
SAR:DL	SAR is incalculable due to undetectable Na. Detection Limit represents maximum possible SAR value.
SAR:INC	SAR is incalculable due to Ca, Mg below detection limit.
SAR:M	Reported SAR represents a maximum value. Actual SAR may be lower if both Ca and Mg were detectable.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
CEC-SK	Soil	Cation Exchange Capacity (NH4OAC Extn)	CSSS(2008) 18(4)

Soil exchange sites are saturated with ammonium, then displaced with sodium. Ammonium in the extract is determined colorimetrically.

EC-SAR-SK	Soil	EC (Saturated Paste)	CSSS 18.2.2/CSSS 18.3.1

After saturated soil paste equilibrium, an extract is obtained by vacuum filtration with conductivity of the extract measured by a conductivity meter.

HG-200.2-CVAA-SK	Soil	Mercury in Soil by CVAAS	EPA 200.2/1631E (mod)

Soil samples are digested with nitric and hydrochloric acids, followed by analysis by CVAAS.

MET-200.2-CCMS-SK	Soil	Metals in Soil by CRC ICPMS	EPA 200.2/6020A (mod)

Soil/sediment is dried, disaggregated, and sieved (2 mm). Strong Acid Leachable Metals in the <2mm fraction are solubilized by heated digestion with nitric and hydrochloric acids. Instrumental analysis is by Collision / Reaction Cell ICPMS.

Limitations: This method is intended to liberate environmentally available metals. Silicate minerals are not solubilized. Some metals may be only partially recovered (matrix dependent), including Al, Ba, Be, Cr, S, Sr, Ti, Tl, V, W, and Zr. Elemental Sulfur may be poorly recovered by this method. Volatile forms of sulfur (e.g. sulfide, H2S) may be excluded if lost during sampling, storage, or digestion.

PH-1:2CACL2-SK	Soil	pH (1:2 Soil:CaCl2 Extraction)	CSSS 2008 16.3

1 part dry soil and 2 parts de-ionized 0.01M CaCl2 (by volume) is mixed. The slurry is allowed to stand with occasional stirring for 30 - 60 minutes. pH of the soil slurry is then measured using a pH meter.

PSA-1-SK	Soil	Particle Size Analysis:Mini-Pipet Method	SSIR-51 Method 3.2.1

Dry, < 2 mm soil is treated with sodium hexametaphosphate to ensure complete dispersion of primary soil particles. The homogenized suspension is allowed to settle in accordance with Stoke’s Law so that only clay particles remain in suspension.To determine the clay fraction, an aliquot of the clay suspension is removed, then dried and weighed. The sand fraction is determined by wet sieving the remaining suspension, then drying and weighing the sand retained on the sieve. The silt fraction is determined by calculation where % Silt = 100 - (%Sand+%Clay)

SAL-MG/KG-CALC-SK	Soil	Detail Salinity in mg/kg	Manual Calculation
SAR-CALC-SK	Soil	SAR and Cations in saturated soil	CSSS 18.4-Calculation

Ca, Mg, Na and K in a saturated soil extract are determined by ICP-OES.

SAT-PCNT-SK	Soil	Saturated Paste	CSSS (1993) 18.2.2

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
SK	ALS ENVIRONMENTAL - SASKATOON, SASKATCHEWAN, CANADA

Chain of Custody Numbers:

Reference Information

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**

GLOSSARY OF REPORT TERMS

Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.
mg/kg - milligrams per kilogram based on dry weight of sample
mg/kg wwt - milligrams per kilogram based on wet weight of sample
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight
mg/L - unit of concentration based on volume, parts per million.
< - Less than.
D.L. - The reporting limit.
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

ALS Environmental

Quality Control Report

Workorder: L2183989 Report Date: 14-NOV-18

Client: Golder Associates Ltd.
1721 8th Street East
Saskatoon SK S7H 0T4

Contact: KYLE HODGSON

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
CEC-SK	**Soil**							
Batch R4326328								
WG2922907-1 DUP		**L2183989-10**						
Cation Exchange Capacity		<0.80	<0.80	RPD-NA	meq/100g	N/A	20	08-NOV-18
WG2922907-3 IRM		**SAL814**						
Cation Exchange Capacity			101.9		%		70-130	08-NOV-18
WG2922907-2 MB								
Cation Exchange Capacity			<0.80		meq/100g		0.8	08-NOV-18
EC-SAR-SK	**Soil**							
Batch R4322487								
WG2922855-1 DUP		**L2183989-9**						
Conductivity Sat. Paste		<0.10	<0.10	RPD-NA	dS m-1	N/A	20	06-NOV-18
WG2922855-3 IRM		**SK-SAL-17**						
Conductivity Sat. Paste			92.9		%		80-120	06-NOV-18
WG2922855-5 LCS								
Conductivity Sat. Paste			99.0		%		80-120	06-NOV-18
WG2922855-2 MB								
Conductivity Sat. Paste			<0.10		dS m-1		0.1	06-NOV-18
HG-200.2-CVAA-SK	**Soil**							
Batch R4322916								
WG2922042-3 CRM		**TILL-1**						
Mercury (Hg)			98.6		%		70-130	06-NOV-18
WG2922042-4 LCS								
Mercury (Hg)			95.0		%		80-120	06-NOV-18
WG2922042-1 MB								
Mercury (Hg)			<0.0050		mg/kg		0.005	06-NOV-18
MET-200.2-CCMS-SK	**Soil**							
Batch R4333729								
WG2922042-3 CRM		**TILL-1**						
Aluminum (Al)			103.6		%		70-130	14-NOV-18
Antimony (Sb)			102.2		%		70-130	14-NOV-18
Arsenic (As)			103.8		%		70-130	14-NOV-18
Barium (Ba)			100.4		%		70-130	14-NOV-18
Beryllium (Be)			106.0		%		70-130	14-NOV-18
Boron (B)			3.0		mg/kg		0-8.2	14-NOV-18
Bismuth (Bi)			92.3		%		70-130	14-NOV-18
Cadmium (Cd)			102.9		%		70-130	14-NOV-18
Calcium (Ca)			103.3		%		70-130	14-NOV-18
Chromium (Cr)			101.7		%		70-130	14-NOV-18

ALS Environmental

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-200.2-CCMS-SK	**Soil**							
Batch R4333729								
WG2922042-3 CRM		**TILL-1**						
Cobalt (Co)			101.8		%		70-130	14-NOV-18
Copper (Cu)			104.1		%		70-130	14-NOV-18
Iron (Fe)			98.4		%		70-130	14-NOV-18
Lead (Pb)			98.3		%		70-130	14-NOV-18
Lithium (Li)			108.4		%		70-130	14-NOV-18
Magnesium (Mg)			99.0		%		70-130	14-NOV-18
Manganese (Mn)			100.5		%		70-130	14-NOV-18
Molybdenum (Mo)			102.6		%		70-130	14-NOV-18
Nickel (Ni)			102.3		%		70-130	14-NOV-18
Phosphorus (P)			108.8		%		70-130	14-NOV-18
Potassium (K)			91.9		%		70-130	14-NOV-18
Selenium (Se)			0.32		mg/kg		0.11-0.51	14-NOV-18
Silver (Ag)			0.24		mg/kg		0.13-0.33	14-NOV-18
Sodium (Na)			93.8		%		70-130	14-NOV-18
Strontium (Sr)			96.5		%		70-130	14-NOV-18
Thallium (Tl)			0.123		mg/kg		0.077-0.18	14-NOV-18
Tin (Sn)			1.3		mg/kg		0-3.1	14-NOV-18
Titanium (Ti)			94.8		%		70-130	14-NOV-18
Tungsten (W)			0.14		mg/kg		0-0.66	14-NOV-18
Uranium (U)			96.2		%		70-130	14-NOV-18
Vanadium (V)			100.1		%		70-130	14-NOV-18
Zinc (Zn)			104.3		%		70-130	14-NOV-18
Zirconium (Zr)			1.0		mg/kg		0-1.8	14-NOV-18
WG2922042-4 LCS								
Aluminum (Al)			105.9		%		80-120	14-NOV-18
Antimony (Sb)			109.6		%		80-120	14-NOV-18
Arsenic (As)			104.2		%		80-120	14-NOV-18
Barium (Ba)			106.3		%		80-120	14-NOV-18
Beryllium (Be)			101.7		%		80-120	14-NOV-18
Boron (B)			102.4		%		80-120	14-NOV-18
Bismuth (Bi)			93.9		%		80-120	14-NOV-18
Cadmium (Cd)			106.8		%		80-120	14-NOV-18
Calcium (Ca)			100.8		%		80-120	14-NOV-18
Chromium (Cr)			105.0		%		80-120	14-NOV-18

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-200.2-CCMS-SK	**Soil**							
Batch R4333729								
WG2922042-4 LCS								
Cobalt (Co)			102.6		%		80-120	14-NOV-18
Copper (Cu)			102.6		%		80-120	14-NOV-18
Iron (Fe)			113.3		%		80-120	14-NOV-18
Lead (Pb)			100.6		%		80-120	14-NOV-18
Lithium (Li)			97.0		%		80-120	14-NOV-18
Magnesium (Mg)			105.9		%		80-120	14-NOV-18
Manganese (Mn)			106.0		%		80-120	14-NOV-18
Molybdenum (Mo)			101.5		%		80-120	14-NOV-18
Nickel (Ni)			104.4		%		80-120	14-NOV-18
Phosphorus (P)			111.0		%		80-120	14-NOV-18
Potassium (K)			105.2		%		80-120	14-NOV-18
Selenium (Se)			105.3		%		80-120	14-NOV-18
Silver (Ag)			104.8		%		80-120	14-NOV-18
Sodium (Na)			104.8		%		80-120	14-NOV-18
Strontium (Sr)			93.4		%		80-120	14-NOV-18
Sulfur (S)			107.5		%		80-120	14-NOV-18
Thallium (Tl)			94.3		%		80-120	14-NOV-18
Tin (Sn)			105.0		%		80-120	14-NOV-18
Titanium (Ti)			96.1		%		80-120	14-NOV-18
Tungsten (W)			97.0		%		80-120	14-NOV-18
Uranium (U)			93.1		%		80-120	14-NOV-18
Vanadium (V)			104.2		%		80-120	14-NOV-18
Zinc (Zn)			104.7		%		80-120	14-NOV-18
Zirconium (Zr)			105.9		%		80-120	14-NOV-18
WG2922042-1 MB								
Aluminum (Al)			<50		mg/kg		50	14-NOV-18
Antimony (Sb)			<0.10		mg/kg		0.1	14-NOV-18
Arsenic (As)			<0.10		mg/kg		0.1	14-NOV-18
Barium (Ba)			<0.50		mg/kg		0.5	14-NOV-18
Beryllium (Be)			<0.10		mg/kg		0.1	14-NOV-18
Boron (B)			<5.0		mg/kg		5	14-NOV-18
Bismuth (Bi)			<0.20		mg/kg		0.2	14-NOV-18
Cadmium (Cd)			<0.020		mg/kg		0.02	14-NOV-18
Calcium (Ca)			<50		mg/kg		50	14-NOV-18

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-200.2-CCMS-SK	**Soil**							
Batch R4333729								
WG2922042-1 MB								
Chromium (Cr)			<0.50		mg/kg		0.5	14-NOV-18
Cobalt (Co)			<0.10		mg/kg		0.1	14-NOV-18
Copper (Cu)			<0.50		mg/kg		0.5	14-NOV-18
Iron (Fe)			<50		mg/kg		50	14-NOV-18
Lead (Pb)			<0.50		mg/kg		0.5	14-NOV-18
Lithium (Li)			<2.0		mg/kg		2	14-NOV-18
Magnesium (Mg)			<20		mg/kg		20	14-NOV-18
Manganese (Mn)			<1.0		mg/kg		1	14-NOV-18
Molybdenum (Mo)			<0.10		mg/kg		0.1	14-NOV-18
Nickel (Ni)			<0.50		mg/kg		0.5	14-NOV-18
Phosphorus (P)			<50		mg/kg		50	14-NOV-18
Potassium (K)			<100		mg/kg		100	14-NOV-18
Selenium (Se)			<0.20		mg/kg		0.2	14-NOV-18
Silver (Ag)			<0.10		mg/kg		0.1	14-NOV-18
Sodium (Na)			<50		mg/kg		50	14-NOV-18
Strontium (Sr)			<0.50		mg/kg		0.5	14-NOV-18
Sulfur (S)			<1000		mg/kg		1000	14-NOV-18
Thallium (Tl)			<0.050		mg/kg		0.05	14-NOV-18
Tin (Sn)			<1.0		mg/kg		1	14-NOV-18
Titanium (Ti)			<1.0		mg/kg		1	14-NOV-18
Tungsten (W)			<0.50		mg/kg		0.5	14-NOV-18
Uranium (U)			<0.050		mg/kg		0.05	14-NOV-18
Vanadium (V)			<0.20		mg/kg		0.2	14-NOV-18
Zinc (Zn)			<2.0		mg/kg		2	14-NOV-18
Zirconium (Zr)			<1.0		mg/kg		1	14-NOV-18
PH-1:2CACL2-SK	**Soil**							
Batch R4321628								
WG2922803-1 DUP		**L2183989-2**						
pH (1:2 CaCl2)		3.18	3.24	J	pH	0.06	0.3	06-NOV-18
WG2922803-2 IRM		**SAL814**						
pH (1:2 CaCl2)			7.66		pH		7.55-8.15	06-NOV-18
WG2922803-3 LCS								
pH (1:2 CaCl2)			6.96		pH		6.66-7.06	06-NOV-18
PSA-1-SK	**Soil**							

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PSA-1-SK	**Soil**							
Batch R4322698								
WG2921509-2 IRM		**2017-PSA**						
% Sand (2.0mm - 0.05mm)			51.7		%		45.8-55.8	06-NOV-18
% Silt (0.05mm - 2um)			34.3		%		28.6-38.6	06-NOV-18
% Clay (<2um)			14.0		%		10.6-20.6	06-NOV-18
WG2921509-3 MB								
% Sand (2.0mm - 0.05mm)			100		%		105	06-NOV-18
% Silt (0.05mm - 2um)			<1.0		%		1	06-NOV-18
% Clay (<2um)			<1.0		%		1	06-NOV-18
SAR-CALC-SK	**Soil**							
Batch R4322910								
WG2922855-1 DUP		**L2183989-9**						
Calcium (Ca)		<5.0	<5.0	RPD-NA	mg/L	N/A	30	06-NOV-18
Potassium (K)		<5.0	<5.0	RPD-NA	mg/L	N/A	30	06-NOV-18
Magnesium (Mg)		<5.0	<5.0	RPD-NA	mg/L	N/A	30	06-NOV-18
Sodium (Na)		<5.0	<5.0	RPD-NA	mg/L	N/A	30	06-NOV-18
WG2922855-3 IRM		**SK-SAL-17**						
Calcium (Ca)			93.1		%		70-130	06-NOV-18
Potassium (K)			90.7		%		70-130	06-NOV-18
Magnesium (Mg)			93.2		%		70-130	06-NOV-18
Sodium (Na)			94.0		%		70-130	06-NOV-18
WG2922855-2 MB								
Calcium (Ca)			<5.0		mg/L		5	06-NOV-18
Potassium (K)			<5.0		mg/L		5	06-NOV-18
Magnesium (Mg)			<5.0		mg/L		5	06-NOV-18
Sodium (Na)			<5.0		mg/L		5	06-NOV-18
SAT-PCNT-SK	**Soil**							
Batch R4322487								
WG2922855-1 DUP		**L2183989-9**						
% Saturation		25.3	28.0		%	10	20	06-NOV-18
WG2922855-3 IRM		**SK-SAL-17**						
% Saturation			105.9		%		80-120	06-NOV-18
WG2922855-5 LCS								
% Saturation			102.0		%		80-120	06-NOV-18
WG2922855-2 MB								
% Saturation			<1.0		%		1	06-NOV-18

Legend:

Limit	ALS Control Limit (Data Quality Objectives)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

Sample Parameter Qualifier Definitions:

Qualifier	Description
DLDS	Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity.
J	Duplicate results and limits are expressed in terms of absolute difference.
RPD-NA	Relative Percent Difference Not Available due to result(s) being less than detection limit.

Hold Time Exceedances:

All test results reported with this submission were conducted within ALS recommended hold times.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.

ALS Environmental

www.alsglobal.com

Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

L2183989-COFC

COC Number: 14 -

Report To	Marcin Stanislawski
Company:	Golder Associates
Contact:	Marcin Stanislawski
Address:	2535 3rd ave SE Calgary, AB T2A 7W5
Phone:	403 880 6786 (cell) 403 509 1858 (work)
Invoice To	Same as Report To ☐ Yes ☑ No
	Copy of Invoice with Report ☐ Yes ☑ No
Company:	Golder Associates
Contact:	Kyle Hodgson

Project Information

ALS Quote #:	
Job #:	1899581
PO / AFE:	
LSD:	

ALS Lab Work Order # (lab use only)

Report Format / Distribution

Select Report Format: ☑ PDF ☑ EXCEL ☑ EDD (DIGITAL)

Quality Control (QC) Report with Report ☑ Yes ☐ No

☐ Criteria on Report - provide details below if box checked

Select Distribution: ☑ EMAIL ☐ MAIL ☐ FAX

Email 1 or Fax Marcin_Stanislawski@golder.com

Email 2 Kyle_Hodgson@golder.com

Invoice Distribution

Select Invoice Distribution: ☑ EMAIL ☐ MAIL ☐ FAX

Email 1 or Fax Kyle_Hodgson@golder.com

Email 2

Oil and Gas Required Fields (client use)

Approver ID:	Cost Center:
GL Account:	Routing Code:
Activity Code:	
Location:	
ALS Contact:	Sampler:

Select Service Level Below (Rush Turnaround Time (TAT) is not available for all tests)

- R ☑ Regular (Standard TAT if received by 3 pm - business days)
- P ☐ Priority (2-4 bus. days if received by 3pm) 50% surcharge - contact ALS to confirm TAT
- E ☐ Emergency (1-2 bus. days if received by 3pm) 100% surcharge - contact ALS to confirm TAT
- E2 ☐ Same day or weekend emergency - contact ALS to confirm TAT and surcharge

Specify Date Required for E2,E or P:

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	SAL-BASIC-ABT1-ED	PSA-1-SK	MET-200.2-CCMS-SK	HG-200.2-CVAA-SK	CEC								Number of Containers
	NR18MS108 LFH (4-0)	16-Oct-18		soil	R		R	R									
	NR18MS108 Aegj (0-14)	16-Oct-18		soil	R	R	R	R	R								
	NR18MS108 Bg (14-40)	16-Oct-18		soil	R	R	R	R									
	NR18MS108 Cg (40-100)	16-Oct-18		soil	R	R	R	R									
	NR18MS77 Of (0-40)	14-Oct-18		soil	R		R	R									
	NR18MS77 Om (40-95)	14-Oct-18		soil	R		R	R									
	NR18MS58 Ae (0-13)	13-Oct-18		soil	R	R	R	R	R								
	NR18MS58 Bm (13-34)	13-Oct-18		soil	R	R	R	R									
	NR18MS58 C (34-100)	13-Oct-18		soil	R	R	R	R									
	NR18MS82 Ae (0-7)	14-Oct-18		soil	R	R	R	R	R								
	NR18MS82 Btj (7-35)	14-Oct-18		soil	R	R	R	R									
	NR18MS96 LFH (9-0)	15-Oct-18		soil	R		R	R									

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System?
☐ Yes ☑ No

Are samples for human drinking water use?
☐ Yes ☑ No

Special Instructions / Specify Criteria to add on report (client Use)

Custody seal intact Yes ☐ No ☐

FINAL SHIPMENT RECEPTION (lab use only)

SHIPMENT RELEASE (client use)

Released by:	Date:	Time:

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

NA-FM-0326a v09 Front/04 January 2014

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

Chain of Custody (COC) / Analytical Request Form

ALS Environmental

Canada Toll Free: 1 800 668 9878

www.alsglobal.com

L2183989-COFC

COC Number: 14 -

Report To	Marcin Stanislawski
Company:	Golder Associates
Contact:	Marcin Stanislawski
Address:	2535 3rd ave SE Calgary, AB T2A 7W5
Phone:	403 880 6786 (cell) 403 509 1858 (work)
Invoice To	Same as Report To ☐ Yes ☑ No
	Copy of Invoice with Report ☐ Yes ☑ No
Company:	Golder Associates
Contact:	Kyle Hodgson

Project Information

ALS Quote #:	
Job #:	1774160
PO / AFE:	
LSD:	
ALS Lab Work Order # (lab use only)	

Report Format / Distribution

Select Report Format: ☑ PDF ☑ EXCEL ☑ EDD (DIGITAL)

Quality Control (QC) Report with Report ☑ Yes ☐ No

☐ Criteria on Report - provide details below if box checked

Select Distribution: ☑ EMAIL ☐ MAIL ☐ FAX

Email 1 or Fax Marcin_Stanislawski@golder.com

Email 2 Kyle_Hodgson@golder.com

Invoice Distribution

Select Invoice Distribution: ☑ EMAIL ☐ MAIL ☐ FAX

Email 1 or Fax Kyle_Hodgson@golder.com

Email 2

Oil and Gas Required Fields (client use)

Approver ID:	Cost Center:
GL Account:	Routing Code:
Activity Code:	
Location:	
ALS Contact:	Sampler:

Select Service Level Below (Rush Turnaround Time (TAT) is not available for all tests)

R ☑ Regular (Standard TAT if received by 3 pm - business days)

P ☐ Priority (2-4 bus. days if received by 3pm) 50% surcharge - contact ALS to confirm TAT

E ☐ Emergency (1-2 bus. days if received by 3pm) 100% surcharge - contact ALS to confirm TAT

E2 ☐ Same day or weekend emergency - contact ALS to confirm TAT and surcharge

Specify Date Required for E2,E or P:

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	SAL-BASIC-ABT1-ED	PSA-1-SK	MET-200.2-CCMS-SK	HG-200.2-CVAA-SK	CEC	Number of Containers
	NR18MS96 Ahe (0-5)	15-Oct-18		soil	R	R	R	R	R	
	NR18MS96 Bmgj (5-24)	15-Oct-18		soil	R	R	R	R		
	NR18MS96 BC (24-55)	15-Oct-18		soil	R	R	R	R		
	NR18MS96 C (55-100)	15-Oct-18		soil	R	R	R	R		
				soil						
				soil						
				soil						
				soil						
				soil						
				soil						
				soil						
				soil						

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System?
☐ Yes ☑ No

Are samples for human drinking water use?
☐ Yes ☑ No

Special Instructions / Specify Criteria to add on report (client Use)

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ SIF Observations Yes ☐ No ☐

Ice packs Yes ☐ No ☐ Custody seal intact Yes ☐ No ☐

SHIPMENT RELEASE (client use)

Released by:	Date:	Time:

FINAL SHIPMENT RECEPTION (lab use only)

Received by: Date: Time:

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

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NA-FM-0326e v09 Front/04 January 2014

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1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

SASKATCHEWAN RESEARCH COUNCIL

Environmental Analytical Laboratories
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Sep 04, 2019

This report was generated for samples included in SRC Group # 2019-11322

Quality Control Report

Kyle Hodgson
Golder
1721 8th Street East
Saskatoon, SK S7H 0T4

Reference Materials and Standards:

A reference material of known concentration is used whenever possible as either a control sample or control standard and analyzed with each batch of samples. These "QC" results are used to assess the performance of the method and must be within clearly defined limits; otherwise corrective action is required.

QC Analysis	Units	Target Value	Obtained Value
Aluminum	ug/g	23600	23400
Arsenic	ug/g	17.0	16.8
Barium	ug/g	99.0	102
Beryllium	ug/g	0.634	0.569
Bismuth	ug/g	1.89	1.88
Cadmium	ug/g	0.244	0.242
Calcium	mg/L	63.4	63.0
Calcium	ug/g	6400	6770
Chloride	mg/L	49.8	50.5
Chloride	mg/L	308	325
Chromium	ug/g	41.4	40.4
Cobalt	ug/g	13.7	12.7
Copper	ug/g	43.6	43.3
Iron	ug/g	37600	35200
Lead	ug/g	13.3	14.1
Lead-210	Bq/L	21.6	18.4
Lead-210	Bq	7.70	6.65
Magnesium	mg/L	16.5	16.4
Magnesium	ug/g	7400	7540
Manganese	ug/g	1230	1220
Mercury	ug/g	0.412	0.349
Mercury	ug/g	0.412	0.346
Molybdenum	ug/g	0.766	0.474
Nickel	ug/g	20.5	20.8
Phosphorus	ug/g	830	769
Polonium-210	Bq/L	18.8	19.9
Polonium-210	Bq	0.077	0.096
Potassium	mg/L	163	164
Potassium	ug/g	1700	1680
Radium-226	Bq/L	18.4	14.8
Radium-226	Bq	2.13	1.87
Radium-226	Bq/L	18.4	18.6

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QC Analysis	Units	Target Value	Obtained Value
Radium-226	Bq	0.043	0.037
Selenium	ug/g	0.420	0.393
Silver	ug/g	0.200	0.219
Sodium	mg/L	100	98.3
Sodium	ug/g	893	873
Strontium	ug/g	27.3	26.8
Sulfate	mg/L	150	147
Thorium-230	Bq/L	19.9	20.6
Thorium-232	Bq	0.203	0.189
Tin	ug/g	1.52	1.46
Titanium	ug/g	1990	2250
Uranium	ug/g	1.20	1.29
Vanadium	ug/g	71.2	69.2
Zinc	ug/g	74.8	80.4

Duplicates:

Duplicates are used to assess problems with precision and help ensure that samples within a given batch were processed appropriately. The difference between duplicates must be within strict limits, otherwise corrective action is required. Please note, the duplicate(s) in this report are duplicates analyzed within a given batch of test samples and may not be from this specific group of samples.

Duplicate Analysis	Units	Sample ID	First Result	Second Result
Silver	ug/g	45051	<0.1	<0.1
Silver	ug/g	45061	<0.1	<0.1
Aluminum	ug/g	45051	3650	3640
Aluminum	ug/g	45061	2580	2680
Arsenic	ug/g	45051	0.9	0.8
Arsenic	ug/g	45061	0.8	0.7
Boron	ug/g	45051	3	4
Boron	ug/g	45061	4	3
Barium	ug/g	45051	28	29
Barium	ug/g	45061	27	29
Beryllium	ug/g	45051	<0.1	<0.1
Beryllium	ug/g	45061	<0.1	<0.1
Bismuth	ug/g	45051	<0.2	<0.2
Bismuth	ug/g	45061	<0.2	<0.2
Calcium	ug/g	45051	330	370
Calcium	ug/g	45061	130	120
Calcium	mg/L	45068	10	9
Cadmium	ug/g	45051	<0.1	<0.1
Cadmium	ug/g	45061	<0.1	<0.1
Chloride	mg/L	45068	4	5
Chloride	mg/L	45847	<1	<1
Cobalt	ug/g	45051	0.5	1.3
Cobalt	ug/g	45061	0.3	0.3

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Duplicate Analysis	Units	Sample ID	First Result	Second Result
Chromium	ug/g	45051	4.2	4.2
Chromium	ug/g	45061	5.0	5.0
Cesium	ug/g	45051	0.1	0.1
Cesium	ug/g	45061	<0.1	<0.1
Copper	ug/g	45051	0.8	1.0
Copper	ug/g	45061	0.5	0.5
Iron	ug/g	45051	2870	2840
Iron	ug/g	45061	2940	2920
Mercury	ug/g	45051	<0.05	<0.05
Mercury	ug/g	45061	<0.05	<0.05
Potassium	ug/g	45051	630	650
Potassium	ug/g	45061	580	630
Potassium	mg/L	45068	7	7
Lithium	ug/g	45051	3.9	3.8
Lithium	ug/g	45061	1.8	1.8
Magnesium	ug/g	45051	360	360
Magnesium	ug/g	45061	130	130
Magnesium	mg/L	45068	2	2
Manganese	ug/g	45051	35	33
Manganese	ug/g	45061	40	43
Molybdenum	ug/g	45051	<0.1	0.7
Molybdenum	ug/g	45061	0.1	0.1
Moisture	%	45068	4.60	4.51
Sodium	ug/g	45051	100	110
Sodium	ug/g	45061	80	80
Sodium	mg/L	45068	3	3
Nickel	ug/g	45051	1.2	1.1
Nickel	ug/g	45061	0.7	0.6
Phosphorus	ug/g	45051	70	70
Phosphorus	ug/g	45061	70	70
Lead	ug/g	45051	2.4	2.4
Lead	ug/g	45061	1.6	1.6
Lead-210	Bq/g	45051	<0.04	<0.04
pH	pH units	45068	3.57	3.61
Polonium-210	Bq/g	45051	<0.01	<0.01
Radium-226	Bq/g	45057	0.02	0.02
Radium-226	Bq/g	45067	<0.01	0.02
Radium-226	Bq/g	45729	0.02	<0.01
Rubidium	ug/g	45051	2.6	2.6
Rubidium	ug/g	45061	2.4	2.6
Antimony	ug/g	45051	<0.2	<0.2
Antimony	ug/g	45061	<0.2	<0.2
Selenium	ug/g	45051	<0.1	<0.1
Selenium	ug/g	45061	<0.1	<0.1
Tin	ug/g	45051	0.2	0.2
Tin	ug/g	45061	0.1	0.1

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Duplicate Analysis	Units	Sample ID	First Result	Second Result
Sulfate	mg/L	45068	12	13
Specific conductivity	uS/cm	45068	176	174
Strontium	ug/g	45051	32	32
Strontium	ug/g	45061	17	18
Tellurium	ug/g	45051	<0.5	<0.5
Tellurium	ug/g	45061	<0.5	<0.5
Thorium-228	Bq/g	45051	<0.02	<0.02
Thorium-230	Bq/g	45051	<0.02	<0.02
Thorium-232	Bq/g	45051	<0.02	<0.02
Titanium	ug/g	45051	280	270
Titanium	ug/g	45061	280	270
Thallium	ug/g	45051	<0.2	<0.2
Thallium	ug/g	45061	<0.2	<0.2
Uranium	ug/g	45051	0.3	0.3
Uranium	ug/g	45061	0.3	0.3
Vanadium	ug/g	45051	8.3	8.2
Vanadium	ug/g	45061	5.2	5.1
Tungsten	ug/g	45051	<0.5	<0.5
Tungsten	ug/g	45061	<0.5	<0.5
Zinc	ug/g	45051	5.4	5.0
Zinc	ug/g	45061	2.5	3.8
Zirconium	ug/g	45051	18	18
Zirconium	ug/g	45061	16	16

Spikes and/or Surrogates:

Samples spiked with a known quantity of the analyte of interest or a surrogate which is a known quantity of a compound which behaves in a similar manner to the analyte of interest, are used to assess problems with the sample processing or sample matrix. The recovery must be within clearly defined limits when the quantity of spike is comparable to the sample concentration.

Spike Analysis	Percent Recovery
Calcium	106
Chloride	100
Magnesium	107
Potassium	105
Sodium	107
Sulfate	101

All quality control results were within the specified limits and considered acceptable.

Roxane Ortmann - Quality Assurance Supervisor

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SRC Group # 2019-11322

Aug 20, 2019

Salinity Package Summary Report

Golder
1721 8th Street East
Saskatoon, SK S7H 0T4
Attn: Kyle Hodgson

SRC Sample #: 45051
Description: 08/08/2019 19-REF04-A-SO *SOIL*

% Saturation:	27.4
pH:	3.75
EC (µS/cm):	188
SAR:	0.3
TGR *:	0

	mg/L	meq/L	ug/g
Calcium:	13	0.65	3.6
Magnesium:	2	0.2	0.5
Sodium:	5	0.2	1
Potassium:	5	0.1	1
Chloride:	5	0.1	1
Sulfate:	10	0.21	2.7

A target value of SAR = 7 is used for this calculation.
If the actual SAR is less than 7, then the TGR = 0.
TGR in tonnes per hectare (15 cm depth).

"Sodium adsorption ratio" (SAR) is a measure of the amount of sodium (Na+) relative to calcium (Ca2+) and magnesium (Mg2+) in the water extracted from a saturated soil paste. It is the ratio of the Na concentration divided by the square root of one-half of the Ca + Mg concentration. SAR is calculated from the equation:

$$SAR = \frac{[Na^+]}{\sqrt{\{[Ca^{2+}] + [Mg^{2+}]\}/2}}$$

Source: U.S. Department of Agriculture, Natural Resources Conservation Service. National soil survey handbook

Theoretical Gypsum Requirement: $TGR = 0.335 \times a^2 \{(1/b^2) - (1/c^2)\} \times (\% \text{ sat.}/100)$
Where: a = Na
b = 7
c = SAR

This report is a summary containing the salinity package analytes.
For all the results requested for this sample, please refer to the complete report.

SRC Group # 2019-11322

Aug 20, 2019

Salinity Package Summary Report

Golder
1721 8th Street East
Saskatoon, SK S7H 0T4
Attn: Kyle Hodgson

SRC Sample #: 45052
Description: 08/11/2019 19-REF04-B-SO *SOIL*

% Saturation:	31.2		
pH:	3.93		
EC (µS/cm):	216		
SAR:	0.1		
TGR *:	0		
	mg/L	meq/L	ug/g
Calcium:	20	1.0	6.2
Magnesium:	3	0.2	0.9
Sodium:	3	0.1	0.9
Potassium:	6	0.2	2
Chloride:	6	0.2	2
Sulfate:	13	0.27	4.1

A target value of SAR = 7 is used for this calculation.
If the actual SAR is less than 7, then the TGR = 0.
TGR in tonnes per hectare (15 cm depth).

"Sodium adsorption ratio" (SAR) is a measure of the amount of sodium (Na+) relative to calcium (Ca2+) and magnesium (Mg2+) in the water extracted from a saturated soil paste. It is the ratio of the Na concentration divided by the square root of one-half of the Ca + Mg concentration. SAR is calculated from the equation:

$$SAR = \frac{[Na^+]}{\sqrt{\{[Ca^{2+}] + [Mg^{2+}]\}/2}}$$

Source: U.S. Department of Agriculture, Natural Resources Conservation Service. National soil survey handbook

Theoretical Gypsum Requirement: $TGR = 0.335 \times a^2 \{(1/b^2) - (1/c^2)\} \times (\% \text{ sat.}/100)$

Where: a = Na
b = 7
c = SAR

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Salinity Package Summary Report

Golder
1721 8th Street East
Saskatoon, SK S7H 0T4
Attn: Kyle Hodgson

SRC Sample #: 45053
Description: 08/11/2019 19-REF04-C-SO *SOIL*

% Saturation:	33.4		
pH:	3.78		
EC (µS/cm):	231		
SAR:	0.2		
TGR *:	0		
	mg/L	meq/L	ug/g
Calcium:	13	0.65	4.3
Magnesium:	3	0.2	1
Sodium:	3	0.1	1
Potassium:	9	0.2	3
Chloride:	6	0.2	2
Sulfate:	11	0.23	3.7

A target value of SAR = 7 is used for this calculation.
If the actual SAR is less than 7, then the TGR = 0.
TGR in tonnes per hectare (15 cm depth).

"Sodium adsorption ratio" (SAR) is a measure of the amount of sodium (Na+) relative to calcium (Ca2+) and magnesium (Mg2+) in the water extracted from a saturated soil paste. It is the ratio of the Na concentration divided by the square root of one-half of the Ca + Mg concentration. SAR is calculated from the equation:

$$SAR = \frac{[Na^{+}]}{\sqrt{\{[Ca^{2+}] + [Mg^{2+}]\}/2}}$$

Source: U.S. Department of Agriculture, Natural Resources Conservation Service. National soil survey handbook

Theoretical Gypsum Requirement: $TGR = 0.335 \times a^2 \{(1/b^2) - (1/c^2)\} \times (\%\ sat./100)$

Where: a = Na
b = 7
c = SAR

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Salinity Package Summary Report

Golder
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Saskatoon, SK S7H 0T4
Attn: Kyle Hodgson

SRC Sample #: 45054
Description: 08/09/2019 19-REF05-A-SO *SOIL*

% Saturation:	29.2		
pH:	4.06		
EC (µS/cm):	201		
SAR:	0.1		
TGR *:	0		
	mg/L	meq/L	ug/g
Calcium:	20	1.0	5.8
Magnesium:	4	0.3	1
Sodium:	3	0.1	0.9
Potassium:	4	0.1	1
Chloride:	4	0.1	1
Sulfate:	12	0.25	3.5

A target value of SAR = 7 is used for this calculation.
If the actual SAR is less than 7, then the TGR = 0.
TGR in tonnes per hectare (15 cm depth).

"Sodium adsorption ratio" (SAR) is a measure of the amount of sodium (Na+) relative to calcium (Ca2+) and magnesium (Mg2+) in the water extracted from a saturated soil paste. It is the ratio of the Na concentration divided by the square root of one-half of the Ca + Mg concentration. SAR is calculated from the equation:

$$SAR = \frac{[Na^+]}{\sqrt{\{[Ca^{2+}] + [Mg^{2+}]\}/2}}$$

Source: U.S. Department of Agriculture, Natural Resources Conservation Service. National soil survey handbook

Theoretical Gypsum Requirement: $TGR = 0.335 \times a^2 \{(1/b^2) - (1/c^2)\} \times (\% \text{ sat.}/100)$

Where: a = Na
b = 7
c = SAR

This report is a summary containing the salinity package analytes.
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Salinity Package Summary Report

Golder
1721 8th Street East
Saskatoon, SK S7H 0T4
Attn: Kyle Hodgson

SRC Sample #: 45055
Description: 08/09/2019 19-REF05-B-SO *SOIL*

% Saturation:	34.5		
pH:	3.80		
EC (µS/cm):	238		
SAR:	0.2		
TGR *:	0		
	mg/L	meq/L	ug/g
Calcium:	18	0.90	6.2
Magnesium:	6	0.5	2
Sodium:	4	0.2	1
Potassium:	7	0.2	2
Chloride:	6	0.2	2
Sulfate:	10	0.21	3.4

A target value of SAR = 7 is used for this calculation.
If the actual SAR is less than 7, then the TGR = 0.
TGR in tonnes per hectare (15 cm depth).

"Sodium adsorption ratio" (SAR) is a measure of the amount of sodium (Na+) relative to calcium (Ca2+) and magnesium (Mg2+) in the water extracted from a saturated soil paste. It is the ratio of the Na concentration divided by the square root of one-half of the Ca + Mg concentration. SAR is calculated from the equation:

$$SAR = \frac{[Na^+]}{\sqrt{\{[Ca^{2+}] + [Mg^{2+}]\}/2}}$$

Source: U.S. Department of Agriculture, Natural Resources Conservation Service. National soil survey handbook

Theoretical Gypsum Requirement: TGR = $0.335 \times a^2 \{(1/b^2) - (1/c^2)\} \times$ (% sat./100)

Where: a = Na
b = 7
c = SAR

This report is a summary containing the salinity package analytes.
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Salinity Package Summary Report

Golder
1721 8th Street East
Saskatoon, SK S7H 0T4
Attn: Kyle Hodgson

SRC Sample #: 45056
Description: 08/09/2019 19-REF05-C-SO *SOIL*

% Saturation:	38.7		
pH:	3.76		
EC (µS/cm):	241		
SAR:	0.3		
TGR *:	0		
	mg/L	meq/L	ug/g
Calcium:	14	0.70	5.4
Magnesium:	5	0.4	2
Sodium:	5	0.2	2
Potassium:	6	0.2	2
Chloride:	6	0.2	2
Sulfate:	14	0.29	5.4

A target value of SAR = 7 is used for this calculation.
If the actual SAR is less than 7, then the TGR = 0.
TGR in tonnes per hectare (15 cm depth).

"Sodium adsorption ratio" (SAR) is a measure of the amount of sodium (Na+) relative to calcium (Ca2+) and magnesium (Mg2+) in the water extracted from a saturated soil paste. It is the ratio of the Na concentration divided by the square root of one-half of the Ca + Mg concentration. SAR is calculated from the equation:

$$SAR = \frac{[Na^+]}{\sqrt{\{[Ca^{2+}] + [Mg^{2+}]\}/2}}$$

Source: U.S. Department of Agriculture, Natural Resources Conservation Service. National soil survey handbook

Theoretical Gypsum Requirement: $TGR = 0.335 \times a^2 \{(1/b^2) - (1/c^2)\} \times (\%\ sat./100)$

Where: $a = Na$
$b = 7$
$c = SAR$

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Salinity Package Summary Report

Golder
1721 8th Street East
Saskatoon, SK S7H 0T4
Attn: Kyle Hodgson

SRC Sample #: 45057
Description: 08/07/2019 19-EXP01-A-SO *SOIL*

% Saturation:	29.2		
pH:	3.39		
EC (µS/cm):	193		
SAR:	0.2		
TGR *:	0		
	mg/L	meq/L	ug/g
Calcium:	10	0.50	2.9
Magnesium:	3	0.2	0.9
Sodium:	2	0.09	0.6
Potassium:	8	0.2	2
Chloride:	4	0.1	1
Sulfate:	18	0.37	5.3

A target value of SAR = 7 is used for this calculation.
If the actual SAR is less than 7, then the TGR = 0.
TGR in tonnes per hectare (15 cm depth).

"Sodium adsorption ratio" (SAR) is a measure of the amount of sodium (Na+) relative to calcium (Ca2+) and magnesium (Mg2+) in the water extracted from a saturated soil paste. It is the ratio of the Na concentration divided by the square root of one-half of the Ca + Mg concentration. SAR is calculated from the equation:

$$SAR = \frac{[Na^{+}]}{\sqrt{\{[Ca^{2+}] + [Mg^{2+}]\}/2}}$$

Source: U.S. Department of Agriculture, Natural Resources Conservation Service. National soil survey handbook

Theoretical Gypsum Requirement: TGR = 0.335 × a^2 {(1/b^2) – (1 /c^2)} × (% sat./100)
Where: a = Na
b = 7
c = SAR

This report is a summary containing the salinity package analytes.
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Salinity Package Summary Report

Golder
1721 8th Street East
Saskatoon, SK S7H 0T4
Attn: Kyle Hodgson

SRC Sample #: 45058
Description: 08/07/2019 19-EXP01-B-SO *SOIL*

% Saturation:	32.8		
pH:	3.17		
EC (µS/cm):	240		
SAR:	0.2		
TGR *:	0		
	mg/L	meq/L	ug/g
Calcium:	8	0.4	3
Magnesium:	2	0.2	0.6
Sodium:	3	0.1	1
Potassium:	12	0.31	3.9
Chloride:	4	0.1	1
Sulfate:	20	0.42	6.6

A target value of SAR = 7 is used for this calculation.
If the actual SAR is less than 7, then the TGR = 0.
TGR in tonnes per hectare (15 cm depth).

"Sodium adsorption ratio" (SAR) is a measure of the amount of sodium (Na+) relative to calcium (Ca2+) and magnesium (Mg2+) in the water extracted from a saturated soil paste. It is the ratio of the Na concentration divided by the square root of one-half of the Ca + Mg concentration. SAR is calculated from the equation:

$$SAR = \frac{[Na^+]}{\sqrt{\{[Ca^{2+}] + [Mg^{2+}]\}/2}}$$

Source: U.S. Department of Agriculture, Natural Resources Conservation Service. National soil survey handbook

Theoretical Gypsum Requirement: TGR = 0.335 × a^2 {($1/b^2$) – ($1/c^2$)} × (% sat./100)
Where: a = Na
b = 7
c = SAR

This report is a summary containing the salinity package analytes.
For all the results requested for this sample, please refer to the complete report.

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E: analytical@src.sk.ca
www.src.sk.ca/analytical

SRC Group # 2019-11322

Aug 20, 2019

Salinity Package Summary Report

Golder
1721 8th Street East
Saskatoon, SK S7H 0T4
Attn: Kyle Hodgson

SRC Sample #: 45059
Description: 08/07/2019 19-EXP01-C-SO *SOIL*

% Saturation:	31.2		
pH:	3.53		
EC (µS/cm):	247		
SAR:	2		
TGR *:	0		
	mg/L	meq/L	ug/g
Calcium:	5	0.2	2
Magnesium:	2	0.2	0.6
Sodium:	22	0.96	6.8
Potassium:	11	0.28	3.4
Chloride:	7	0.2	2
Sulfate:	20	0.42	6.2

A target value of SAR = 7 is used for this calculation.
If the actual SAR is less than 7, then the TGR = 0.
TGR in tonnes per hectare (15 cm depth).

"Sodium adsorption ratio" (SAR) is a measure of the amount of sodium (Na+) relative to calcium (Ca2+) and magnesium (Mg2+) in the water extracted from a saturated soil paste. It is the ratio of the Na concentration divided by the square root of one-half of the Ca + Mg concentration. SAR is calculated from the equation:

$$SAR = \frac{[Na^+]}{\sqrt{\{[Ca^{2+}] + [Mg^{2+}]\}/2}}$$

Source: U.S. Department of Agriculture, Natural Resources Conservation Service. National soil survey handbook

Theoretical Gypsum Requirement: $TGR = 0.335 \times a^2 \{(1/b^2) - (1/c^2)\} \times (\% \text{ sat.}/100)$

Where: a = Na
b = 7
c = SAR

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Aug 20, 2019

Salinity Package Summary Report

Golder
1721 8th Street East
Saskatoon, SK S7H 0T4
Attn: Kyle Hodgson

SRC Sample #: 45060
Description: 08/07/2019 19-EXP02-A-SO *SOIL*

% Saturation:	27.9		
pH:	3.17		
EC (µS/cm):	233		
SAR:	0.2		
TGR *:	0		
	mg/L	meq/L	ug/g
Calcium:	6	0.3	2
Magnesium:	3	0.2	0.8
Sodium:	2	0.09	0.6
Potassium:	7	0.2	2
Chloride:	4	0.1	1
Sulfate:	23	0.48	6.4

A target value of SAR = 7 is used for this calculation.
If the actual SAR is less than 7, then the TGR = 0.
TGR in tonnes per hectare (15 cm depth).

"Sodium adsorption ratio" (SAR) is a measure of the amount of sodium (Na+) relative to calcium (Ca2+) and magnesium (Mg2+) in the water extracted from a saturated soil paste. It is the ratio of the Na concentration divided by the square root of one-half of the Ca + Mg concentration. SAR is calculated from the equation:

$$SAR = \frac{[Na^{+}]}{\sqrt{\{[Ca^{2+}] + [Mg^{2+}]\}/2}}$$

Source: U.S. Department of Agriculture, Natural Resources Conservation Service. National soil survey handbook

Theoretical Gypsum Requirement: TGR = 0.335 × a^2 {(1/b^2) – (1 /c^2)} × (% sat./100)
Where: a = Na
b = 7
c = SAR

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SRC Group # 2019-11322

Aug 20, 2019

Salinity Package Summary Report

Golder
1721 8th Street East
Saskatoon, SK S7H 0T4
Attn: Kyle Hodgson

SRC Sample #: 45061
Description: 08/07/2019 19-EXP02-B-SO *SOIL*

% Saturation:	36.5		
pH:	3.18		
EC (µS/cm):	295		
SAR:	0.3		
TGR *:	0		
	mg/L	meq/L	ug/g
Calcium:	13	0.65	4.8
Magnesium:	4	0.3	1
Sodium:	5	0.2	2
Potassium:	10	0.26	3.6
Chloride:	9	0.2	3
Sulfate:	32	0.67	12

A target value of SAR = 7 is used for this calculation.
If the actual SAR is less than 7, then the TGR = 0.
TGR in tonnes per hectare (15 cm depth).

"Sodium adsorption ratio" (SAR) is a measure of the amount of sodium (Na+) relative to calcium (Ca2+) and magnesium (Mg2+) in the water extracted from a saturated soil paste. It is the ratio of the Na concentration divided by the square root of one-half of the Ca + Mg concentration. SAR is calculated from the equation:

$$SAR = \frac{[Na^+]}{\sqrt{\{[Ca^{2+}] + [Mg^{2+}]\}/2}}$$

Source: U.S. Department of Agriculture, Natural Resources Conservation Service. National soil survey handbook

Theoretical Gypsum Requirement: TGR = 0.335 × a^2 {(1/b^2) – (1 /c^2)} × (% sat./100)
Where: a = Na
b = 7
c = SAR

This report is a summary containing the salinity package analytes.
For all the results requested for this sample, please refer to the complete report.

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SRC Group # 2019-11322

Aug 20, 2019

Salinity Package Summary Report

Golder
1721 8th Street East
Saskatoon, SK S7H 0T4
Attn: Kyle Hodgson

SRC Sample #: 45062
Description: 08/07/2019 19-EXP02-C-SO *SOIL*

% Saturation:	37.0		
pH:	3.08		
EC (µS/cm):	345		
SAR:	0.7		
TGR *:	0		
	mg/L	meq/L	ug/g
Calcium:	5	0.2	2
Magnesium:	2	0.2	0.7
Sodium:	6	0.3	2
Potassium:	11	0.28	4.1
Chloride:	9	0.2	3
Sulfate:	31	0.64	11

A target value of SAR = 7 is used for this calculation.
If the actual SAR is less than 7, then the TGR = 0.
TGR in tonnes per hectare (15 cm depth).

"Sodium adsorption ratio" (SAR) is a measure of the amount of sodium (Na+) relative to calcium (Ca2+) and magnesium (Mg2+) in the water extracted from a saturated soil paste. It is the ratio of the Na concentration divided by the square root of one-half of the Ca + Mg concentration. SAR is calculated from the equation:

$$SAR = \frac{[Na^+]}{\sqrt{\{[Ca^{2+}] + [Mg^{2+}]\}/2}}$$

Source: U.S. Department of Agriculture, Natural Resources Conservation Service. National soil survey handbook

Theoretical Gypsum Requirement: TGR = 0.335 × a² {(1/b²) – (1 /c²)} × (% sat./100)

Where: a = Na
b = 7
c = SAR

This report is a summary containing the salinity package analytes.
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Salinity Package Summary Report

Golder
1721 8th Street East
Saskatoon, SK S7H 0T4
Attn: Kyle Hodgson

SRC Sample #: 45063
Description: 08/10/2019 19-REF06-A-SO *SOIL*

% Saturation:	29.0		
pH:	3.42		
EC (µS/cm):	163		
SAR:	0.2		
TGR *:	0		
	mg/L	meq/L	ug/g
Calcium:	10	0.50	2.9
Magnesium:	2	0.2	0.6
Sodium:	2	0.09	0.6
Potassium:	6	0.2	2
Chloride:	4	0.1	1
Sulfate:	14	0.29	4.0

A target value of SAR = 7 is used for this calculation.
If the actual SAR is less than 7, then the TGR = 0.
TGR in tonnes per hectare (15 cm depth).

"Sodium adsorption ratio" (SAR) is a measure of the amount of sodium (Na+) relative to calcium (Ca2+) and magnesium (Mg2+) in the water extracted from a saturated soil paste. It is the ratio of the Na concentration divided by the square root of one-half of the Ca + Mg concentration. SAR is calculated from the equation:

$$SAR = \frac{[Na^+]}{\sqrt{\{[Ca^{2+}] + [Mg^{2+}]\}/2}}$$

Source: U.S. Department of Agriculture, Natural Resources Conservation Service. National soil survey handbook

Theoretical Gypsum Requirement: TGR = 0.335 × a² {(1/b²) – (1 /c²)} × (% sat./100)
Where: a = Na
b = 7
c = SAR

This report is a summary containing the salinity package analytes.
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Salinity Package Summary Report

Golder
1721 8th Street East
Saskatoon, SK S7H 0T4
Attn: Kyle Hodgson

SRC Sample #: 45064
Description: 08/10/2019 19-REF06-B-SO *SOIL*

% Saturation:	36.6		
pH:	3.59		
EC (µS/cm):	323		
SAR:	0.1		
TGR *:	0		
	mg/L	meq/L	ug/g
Calcium:	24	1.2	8.8
Magnesium:	5	0.4	2
Sodium:	3	0.1	1
Potassium:	22	0.56	8.0
Chloride:	11	0.31	4.0
Sulfate:	27	0.56	9.9

A target value of SAR = 7 is used for this calculation.
If the actual SAR is less than 7, then the TGR = 0.
TGR in tonnes per hectare (15 cm depth).

"Sodium adsorption ratio" (SAR) is a measure of the amount of sodium (Na+) relative to calcium (Ca2+) and magnesium (Mg2+) in the water extracted from a saturated soil paste. It is the ratio of the Na concentration divided by the square root of one-half of the Ca + Mg concentration. SAR is calculated from the equation:

$$SAR = \frac{[Na^+]}{\sqrt{\{[Ca^{2+}] + [Mg^{2+}]\}/2}}$$

Source: U.S. Department of Agriculture, Natural Resources Conservation Service. National soil survey handbook

Theoretical Gypsum Requirement: TGR = 0.335 × a^2 {($1/b^2$) – ($1/c^2$)} × (% sat./100)
Where: a = Na
b = 7
c = SAR

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Golder
1721 8th Street East
Saskatoon, SK S7H 0T4
Attn: Kyle Hodgson

SRC Sample #: 45065
Description: 08/10/2019 19-REF06-C-SO *SOIL*

% Saturation:	25.7		
pH:	3.85		
EC (µS/cm):	177		
SAR:	0.2		
TGR *:	0		
	mg/L	meq/L	ug/g
Calcium:	11	0.55	2.8
Magnesium:	4	0.3	1
Sodium:	3	0.1	0.8
Potassium:	8	0.2	2
Chloride:	4	0.1	1
Sulfate:	6	0.1	2

A target value of SAR = 7 is used for this calculation.
If the actual SAR is less than 7, then the TGR = 0.
TGR in tonnes per hectare (15 cm depth).

"Sodium adsorption ratio" (SAR) is a measure of the amount of sodium (Na+) relative to calcium (Ca2+) and magnesium (Mg2+) in the water extracted from a saturated soil paste. It is the ratio of the Na concentration divided by the square root of one-half of the Ca + Mg concentration. SAR is calculated from the equation:

$$SAR = \frac{[Na^+]}{\sqrt{\{[Ca^{2+}] + [Mg^{2+}]\}/2}}$$

Source: U.S. Department of Agriculture, Natural Resources Conservation Service. National soil survey handbook

Theoretical Gypsum Requirement: $TGR = 0.335 \times a^2 \{(1/b^2) - (1/c^2)\} \times (\% \text{ sat.}/100)$

Where: a = Na
b = 7
c = SAR

This report is a summary containing the salinity package analytes.
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Salinity Package Summary Report

Golder
1721 8th Street East
Saskatoon, SK S7H 0T4
Attn: Kyle Hodgson

SRC Sample #: 45066
Description: 08/08/2019 19-EXP03-A-SO *SOIL*

% Saturation:	32.1		
pH:	4.27		
EC (µS/cm):	154		
SAR:	0.2		
TGR *:	0		
	mg/L	meq/L	ug/g
Calcium:	10	0.50	3.2
Magnesium:	3	0.2	1
Sodium:	2	0.09	0.6
Potassium:	6	0.2	2
Chloride:	4	0.1	1
Sulfate:	10	0.21	3.2

A target value of SAR = 7 is used for this calculation.
If the actual SAR is less than 7, then the TGR = 0.
TGR in tonnes per hectare (15 cm depth).

"Sodium adsorption ratio" (SAR) is a measure of the amount of sodium (Na+) relative to calcium (Ca2+) and magnesium (Mg2+) in the water extracted from a saturated soil paste. It is the ratio of the Na concentration divided by the square root of one-half of the Ca + Mg concentration. SAR is calculated from the equation:

$$SAR = \frac{[Na^+]}{\sqrt{\{[Ca^{2+}] + [Mg^{2+}]\}/2}}$$

Source: U.S. Department of Agriculture, Natural Resources Conservation Service. National soil survey handbook

Theoretical Gypsum Requirement: $TGR = 0.335 \times a^2 \{(1/b^2) - (1/c^2)\} \times (\% \text{ sat.}/100)$

Where: a = Na
b = 7
c = SAR

This report is a summary containing the salinity package analytes.
For all the results requested for this sample, please refer to the complete report.

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Aug 20, 2019

Salinity Package Summary Report

Golder
1721 8th Street East
Saskatoon, SK S7H 0T4
Attn: Kyle Hodgson

SRC Sample #: 45067
Description: 08/08/2019 19-EXP03-B-SO *SOIL*

% Saturation:	23.2		
pH:	3.75		
EC (µS/cm):	174		
SAR:	0.5		
TGR *:	0		
	mg/L	meq/L	ug/g
Calcium:	10	0.50	2.3
Magnesium:	2	0.2	0.5
Sodium:	6	0.3	1
Potassium:	10	0.26	2.3
Chloride:	5	0.1	1
Sulfate:	12	0.25	2.8

A target value of SAR = 7 is used for this calculation.
If the actual SAR is less than 7, then the TGR = 0.
TGR in tonnes per hectare (15 cm depth).

"Sodium adsorption ratio" (SAR) is a measure of the amount of sodium (Na+) relative to calcium (Ca2+) and magnesium (Mg2+) in the water extracted from a saturated soil paste. It is the ratio of the Na concentration divided by the square root of one-half of the Ca + Mg concentration. SAR is calculated from the equation:

$$SAR = \frac{[Na^+]}{\sqrt{\{[Ca^{2+}] + [Mg^{2+}]\}/2}}$$

Source: U.S. Department of Agriculture, Natural Resources Conservation Service. National soil survey handbook

Theoretical Gypsum Requirement: TGR = 0.335 × a^2 {(1/b^2) – (1 /c^2)} × (% sat./100)
Where: a = Na
b = 7
c = SAR

This report is a summary containing the salinity package analytes.
For all the results requested for this sample, please refer to the complete report.

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SRC Group # 2019-11322

Aug 20, 2019

Salinity Package Summary Report

Golder
1721 8th Street East
Saskatoon, SK S7H 0T4
Attn: Kyle Hodgson

SRC Sample #: 45068
Description: 08/08/2019 19-EXP03-C-SO *SOIL*

% Saturation:	24.5
pH:	3.57
EC (µS/cm):	176
SAR:	0.2
TGR *:	0

	mg/L	meq/L	ug/g
Calcium:	10	0.50	2.4
Magnesium:	2	0.2	0.5
Sodium:	3	0.1	0.7
Potassium:	7	0.2	2
Chloride:	4	0.1	1
Sulfate:	12	0.25	2.9

A target value of SAR = 7 is used for this calculation.
If the actual SAR is less than 7, then the TGR = 0.
TGR in tonnes per hectare (15 cm depth).

"Sodium adsorption ratio" (SAR) is a measure of the amount of sodium (Na+) relative to calcium (Ca2+) and magnesium (Mg2+) in the water extracted from a saturated soil paste. It is the ratio of the Na concentration divided by the square root of one-half of the Ca + Mg concentration. SAR is calculated from the equation:

$$SAR = \frac{[Na^+]}{\sqrt{\{[Ca^{2+}] + [Mg^{2+}]\}/2}}$$

Source: U.S. Department of Agriculture, Natural Resources Conservation Service. National soil survey handbook

Theoretical Gypsum Requirement: TGR = 0.335 × a^2 {(1/b^2) – (1 /c^2)} × (% sat./100)
Where: a = Na
b = 7
c = SAR

This report is a summary containing the salinity package analytes.
For all the results requested for this sample, please refer to the complete report.

APPENDIX C

Soils Inspection Site Data

Table C-1: Terrain and Soil Characteristics Obtained at Each Inspection Site

Site	Soil Order	Subgroup[a]	Horizon	Texture	Structure[b]	Top Depth (cm)	Bottom Depth (cm)	Horizon Thickness (cm)	Color	Mottle Abundance	Mottle Dimension	Mottle Contrast	Mottle Color	Drainage[c]	Slope Position[d]	Slope Class[e]	Parent Material[f]
NR18MS001	Brunisol	GLE.DYB	LFH	-	SGR	14	0	14	-	-	-	-	-				
			Ae	sand	SGR	0	10	10	10YR 5/3	-	-	-	-	MW	T	3	GLFL
			Bmgj	sand	SGR	10	24	14	7.5YR 3/3	-	-	-	-				
			BC	sand	SGR	24	40	16	7.5YR 6/3	-	-	-	-				
NR18MS002	Brunisol	E.DYB	LFH	-	-	9	0	9	-	-	-	-	-	R	L	5	GLFL
			Ae	sand	SGR	0	23	23	-	-	-	-	-				
			Bm	sand	SGR	23	50	27	-	-	-	-	-				
			BC	loamy sand	MA	50	65	15	-	-	-	-	-				
NR18MS003	Brunisol	GLE.DYB	LFH	-	-	20	0	20	-	-	-	-	-	-	-	-	GLFL
			Aegj	sand	SGR	0	10	10	-	-	-	-	-				
			Bmgj	sand	SGR	10	30	20	-	-	-	-	-				
NR18MS004	Brunisol	E.DYB	LFH	-	-	5	0	5	-	-	-	-	-	R	M	4	GLFL
			Ae	sand	SGR	0	28	28	7.5YR 7/1	-	-	-	-				
			Bm	sand	SGR	28	55	27	7.5YR 5/8	-	-	-	-				
			BC	sand	SGR	55	65	10	-	-	-	-	-				
NR18MS005	Brunisol	E.DYB	LFH	-	-	5	0	5	-	-	-	-	-	R	M	4	GLFL
			Ae	sand	SGR	0	14	14	7.5YR 7/1	-	-	-	-				
			Bm	sand	SGR	14	26	12	7.5YR 5/8	-	-	-	-				
			BC	sand	SGR	26	50	24	-	-	-	-	-				
			C	sand	SGR	50	75	25	-	-	-	-	-				
NR18MS006	Brunisol	E.DYB	LFH	-	-	3	0	3	-	-	-	-	-	R	U	7	GLFL
			Ae	sand	SGR	0	20	20	-	-	-	-	-				
			Bm	sand	SGR	20	35	15	-	-	-	-	-				
			BC	sandy loam	MA	35	45	10	-	-	-	-	-				
NR18MS007	Brunisol	E.DYB	LFH	-	-	6	0	6	-	-	-	-	-	W	L	4	GLFL
			Ae	sand	-	0	12	12	-	-	-	-	-				
			Bm	sand	-	12	33	21	-	-	-	-	-				
			BC	sand	-	33	65	32	-	-	-	-	-				
			C	loamy sand	-	65	100	35	-	-	-	-	-				
NR18MS008	Brunisol	E.DYB	LFH	-	-	5	0	5	-	-	-	-	-	R	U	4	GLFL
			Ae	sand	-	0	32	32	-	-	-	-	-				
			Bm	sand	-	32	45	13	-	-	-	-	-				
NR18MS009	Brunisol	E.DYB	LFH	-	-	3	0	3	-	-	-	-	-	R	U	3	GLFL
			Ae	sand	-	0	19	19	-	-	-	-	-				
			Bm	sand	-	19	35	16	-	-	-	-	-				
NR18MS010	Brunisol	E.DYB	LFH	-	-	3	0	3	-	-	-	-	-	R	U	5	GLFL
			Ae	sand	-	0	25	25	-	-	-	-	-				
			Bm	sand	-	25	40	15	-	-	-	-	-				
NR18MS011	Brunisol	E.DYB	LFH	-	-	6	0	6	-	-	-	-	-	R	U	5	GLFL
			Ae	sand	-	0	30	30	-	-	-	-	-				
			Bm	sand	-	30	60	30	-	-	-	-	-				
NR18MS012	Brunisol	E.DYB	LFH	-	-	5	0	5	-	-	-	-	-	R	U	5	GLFL
			Ae	sand	SGR	0	25	25	-	-	-	-	-				
			Bm	sand	SGR	25	35	10	-	-	-	-	-				

Table C-1: Terrain and Soil Characteristics Obtained at Each Inspection Site

Site	Soil Order	Subgroup[a]	Horizon	Texture	Structure[b]	Top Depth (cm)	Bottom Depth (cm)	Horizon Thickness (cm)	Color	Mottle Abundance	Mottle Dimension	Mottle Contrast	Mottle Color	Drainage[c]	Slope Position[d]	Slope Class[e]	Parent Material[f]
NR18MS013	Brunisol	E.DYB	LFH	-	-	6	0	6	-	-	-	-	-	R	M	6	GLFL
			Ae	sand	SGR	0	30	30	-	-	-	-	-				
			Bm	sandy loam	SGR	30	35	5	-	-	-	-	-				
NR18MS014	Brunisol	E.DYB	LFH	-	-	5	0	5	-	-	-	-	-	R	L	4	GLFL
			Ae	sand	SGR	0	15	15	-	-	-	-	-				
			Bm	sand	SGR	15	27	12	-	-	-	-	-				
			BCgj	sand	SGR	27	55	28	-	-	-	-	-				
			C	sand	SGR	55	100	45	-	-	-	-	-				
NR18MS015	Brunisol	GLE.DYB	Of	-	-	10	4	6	-	-	-	-	-	I	L	3	GLFL
			Oh	-	-	4	0	4	-	-	-	-	-				
			Aegj	loamy sand	PL	0	18	18	-	-	-	-	-				
			Bmgj	loamy sand	SBK	18	40	22	7.5YR 4/3	Few	Coarse	Faint	Faint				
			BCg	loamy sand	MA	40	100	60	-	-	-	-	-				
NR18MS016	Brunisol	E.DYB	LFH	-	-	2	0	2	-	-	-	-	-	R	C	2	GLFL
			Ae	sand	SGR	4	35	31	-	-	-	-	-				
			Ahe	sand	SGR	0	4	4	-	-	-	-	-				
			Bm	sand	SGR	35	45	10	-	-	-	-	-				
NR18MS017	Brunisol	E.DYB	LFH	-	-	5	0	5	-	-	-	-	-	W	L	3	GLFL
			Ae	loamy sand	PL	0	12	12	-	-	-	-	-				
			Bm	sand	SGR	12	30	18	-	-	-	-	-				
			C	sand	SGR	30	75	45	-	-	-	-	-				
NR18MS018	Brunisol	E.DYB	LFH	-	-	5	0	5	-	-	-	-	-	W	L	5	GLFL
			Ae	loamy sand	PL	0	10	10	-	-	-	-	-				
			Bm	sandy loam	SBK	10	40	30	-	-	-	-	-				
			C	sand	SGR	40	50	10	-	-	-	-	-				
NR18MS019	Brunisol	E.DYB	LFH	-	-	3	0	3	-	-	-	-	-	R	U	2	GLFL
			Ae	sand	SGR	0	12	12	7.5YR 6/2	-	-	-	-				
			Bm	loamy sand	SBK	12	26	14	10YR 5/8	-	-	-	-				
			C	sandy loam	MA	55	100	45	-	-	-	-	-				
			C	sand	SGR	26	55	29	10YR 7/6	-	-	-	-				
NR18MS020	Brunisol	E.DYB	LFH	-	-	3	0	3	-	-	-	-	-	R	U	2	GLFL
			Ae	sand	PL	0	9	9	7.5YR 6/2	-	-	-	-				
			Bm	loamy sand	SBK	9	22	13	10YR 5/8	-	-	-	-				
			BC	loamy sand	-	22	40	18	-	-	-	-	-				
			C	sand	-	40	60	20	-	-	-	-	-				
NR18MS021	Brunisol	E.DYB	LFH	-	-	2	0	2	-	-	-	-	-	W	U	2	GLFL
			Ae	loamy sand	-	0	20	20	-	-	-	-	-				
			Bm	loamy sand	-	20	40	20	-	-	-	-	-				
			C	sand	-	40	45	5	-	-	-	-	-				

Table C-1: Terrain and Soil Characteristics Obtained at Each Inspection Site

Site	Soil Order	Subgroup[a]	Horizon	Texture	Structure[b]	Top Depth (cm)	Bottom Depth (cm)	Horizon Thickness (cm)	Color	Mottle Abundance	Mottle Dimension	Mottle Contrast	Mottle Color	Drainage[c]	Slope Position[d]	Slope Class[e]	Parent Material[f]
NR18MS022	Brunisol	E.DYB	LFH	-	-	3	0	3	-	-	-	-	-	W	C	1	GLFL
			Ae	sand	SGR	0	18	18	-	-	-	-	-				
			Bm	loamy sand	SBK	18	45	27	-	-	-	-	-				
			C	sand	SGR	45	60	15	-	-	-	-	-				
NR18MS023	Brunisol	E.DYB	LFH	-	-	1	0	1	-	-	-	-	-	W	C	2	GLFL
			Ae	loamy sand	PL	0	6	6	-	-	-	-	-				
			Bm	loamy sand	SBK	6	30	24	-	-	-	-	-				
			C	sand	SGR	30	45	15	-	-	-	-	-				
NR18MS024	Brunisol	E.DYB	LFH	-	-	3	0	3	-	-	-	-	-	R	U	3	GLFL
			Ae	sand	SGR	0	22	22	-	-	-	-	-				
			Bm	sand	SGR	22	40	18	-	-	-	-	-				
			BC	sand	SGR	40	50	10	-	-	-	-	-				
NR18MS025	Brunisol	E.DYB	LFH	-	-	4	0	4	-	-	-	-	-	R	U	3	GLFL
			Ae	loamy sand	PL	0	22	22	-	-	-	-	-				
			Bm	loamy sand	SBK	22	35	13	-	-	-	-	-				
			BC	sand	SGR	35	50	15	-	-	-	-	-				
NR18MS026	Brunisol	E.DYB	LFH	-	-	2	0	2	-	-	-	-	-	R	U	3	GLFL
			Ae	sand	SGR	0	15	15	-	-	-	-	-				
			Bm	sand	SGR	15	40	25	-	-	-	-	-				
			C	sand	SGR	40	50	10	-	-	-	-	-				
NR18MS027	Brunisol	E.DYB	LFH	-	-	2	0	2	-	-	-	-	-	R	L	4	GLFL
			Ae	loamy sand	PL	0	20	20	-	-	-	-	-				
			Bm	loamy sand	SBK	20	35	15	-	-	-	-	-				
			C	sand	SGR	35	65	30	-	-	-	-	-				
			C	sand	SGR	65	75	10	-	-	-	-	-				
NR18MS028	Brunisol	E.DYB	LFH	-	-	3	0	3	-	-	-	-	-	R	C	3	GLFL
			Ae	loamy sand	PL	0	9	9	-	-	-	-	-				
			Bm	loamy sand	SGR	9	35	26	-	-	-	-	-				
			C	sand	SGR	35	45	10	-	-	-	-	-				
NR18MS029	Brunisol	E.DYB	LFH	-	-	1	0	1	-	-	-	-	-	W	L	5	GLFL
			Ae	loamy sand	PL	0	7	7	10YR 6/1	-	-	-	-				
			Btj	sandy loam	SBK	22	35	13	10YR 5/6	-	-	-	-				
			Bm	loamy sand	SBK	7	22	15	10YR 5/8	-	-	-	-				
			BC	sandy loam	MA	35	50	15	2.5Y 7/2	-	-	-	-				
			C	sand	SGR	50	75	25	7.5YR 7/3	-	-	-	-				
NR18MS030	Brunisol	E.DYB	LFH	-	-	2	0	2	-	-	-	-	-	R	M	4	GLFL
			Ae	sand	SGR	0	20	20	-	-	-	-	-				
			Bm	sand	SGR	20	40	20	-	-	-	-	-				
			C	sand	SGR	40	100	60	-	-	-	-	-				

Table C-1: Terrain and Soil Characteristics Obtained at Each Inspection Site

Site	Soil Order	Subgroup[a]	Horizon	Texture	Structure[b]	Top Depth (cm)	Bottom Depth (cm)	Horizon Thickness (cm)	Color	Mottle Abundance	Mottle Dimension	Mottle Contrast	Mottle Color	Drainage[c]	Slope Position[d]	Slope Class[e]	Parent Material[f]
NR18MS031	Brunisol	E.DYB	LFH	-	-	1	0	1	-	-	-	-	-	W	U	4	GLFL
			Ae	sand	SGR	1	18	17	-	-	-	-	-				
			Ah	loamy sand	-	0	1	1	-	-	-	-	-				
			Btj	sandy loam	SBK	18	40	22	-	-	-	-	-				
NR18MS032	Brunisol	E.DYB	LFH	-	-	3	0	3	-	-	-	-	-	W	C	2	GLFL
			Ae	loamy sand	PL	0	16	16	-	-	-	-	-				
			Bm	loamy sand	SBK	16	37	21	-	-	-	-	-				
			C	sand	SGR	37	70	33	-	-	-	-	-				
NR18MS033	Brunisol	GLE.DYB	LFH	-	-	4	0	4	-	-	-	-	-	MW	L	2	GLFL
			Aegj	loamy sand	-	8	20	12	-	-	-	-	-				
			Ahe	loamy sand	-	0	8	8	-	-	-	-	-				
			Btjgj	sandy loam	SBK	20	38	18	-	Common	Medium	Faint	Faint				
			BCgj	sandy loam	MA	38	75	37	-	-	-	-	-				
NR18MS034	Brunisol	E.DYB	LFH	-	-	1	0	1	-	-	-	-	-	MW	U	3	GLFL
			Ae	loamy sand	-	0	12	12	-	-	-	-	-				
			Bm	loamy sand	-	12	30	18	-	-	-	-	-				
			C	loamy sand	-	30	45	15	-	-	-	-	-				
NR18MS035	Brunisol	E.DYB	LFH	-	-	1	0	1	-	-	-	-	-	MW	U	3	GLFL
			Ae	loamy sand	-	0	9	9	-	-	-	-	-				
			Bm	loamy sand	-	9	26	17	-	-	-	-	-				
			C	loamy sand	-	26	30	4	-	-	-	-	-				
NR18MS036	Brunisol	E.DYB	LFH	-	-	2	0	2	-	-	-	-	-	W	M	5	GLFL
			Ae	loamy sand	PL	0	15	15	-	-	-	-	-				
			Bm	loamy sand	SBK	15	37	22	-	-	-	-	-				
			C	loamy sand	SGR	37	40	3	-	-	-	-	-				
NR18MS037	Brunisol	E.DYB	LFH	-	-	2	0	2	-	-	-	-	-	W	C	3	GLFL
			Ae	loamy sand	PL	0	10	10	-	-	-	-	-				
			Bm	loamy sand	SBK	10	22	12	-	-	-	-	-				
			BC	loamy sand	SBK	22	37	15	-	-	-	-	-				
			C	loamy sand	-	37	65	28	-	-	-	-	-				

Table C-1: Terrain and Soil Characteristics Obtained at Each Inspection Site

Site	Soil Order	Subgroup[a]	Horizon	Texture	Structure[b]	Top Depth (cm)	Bottom Depth (cm)	Horizon Thickness (cm)	Color	Mottle Abundance	Mottle Dimension	Mottle Contrast	Mottle Color	Drainage[c]	Slope Position[d]	Slope Class[e]	Parent Material[f]
NR18MS038	Brunisol	E.DYB	LFH	-	-	2	0	2	-	-	-	-	-	R	M	3	GLFL
			Ae	sand	SGR	5	20	15	7.5YR 6/2	-	-	-	-				
			Ahe	loamy sand	SGR	0	5	5	7.5YR 4/1	-	-	-	-				
			Bm	loamy sand	SBK	20	40	20	10YR 5/6	-	-	-	-				
			C	sand	SGR	40	50	10	-	-	-	-	-				
NR18MS039	Brunisol	E.DYB	LFH	-	-	1	0	1	-	-	-	-	-	R	U	2	GLFL
			Ae	sand	SGR	2	11	9	-	-	-	-	-				
			Ahe	loamy sand	-	0	2	2	-	-	-	-	-				
			Bm	loamy sand	SBK	11	36	25	-	-	-	-	-				
			C	sand	SGR	36	80	44	-	-	-	-	-				
NR18MS040	Brunisol	E.DYB	LFH	-	-	1	0	1	-	-	-	-	-	R	V	2	GLFL
			Ae	loamy sand	-	0	10	10	-	-	-	-	-				
			Bm	loamy sand	-	10	29	19	-	-	-	-	-				
			C	sand	SGR	29	60	31	-	-	-	-	-				
NR18MS041	Brunisol	E.DYB	LFH	-	-	1	0	1	-	-	-	-	-	R	M	3	GLFL
			Ae	loamy sand	SGR	0	17	17	-	-	-	-	-				
			Bm	loamy sand	SBK	17	40	23	-	-	-	-	-				
			C	sand	SBK	40	70	30	-	-	-	-	-				
NR18MS042	Brunisol	E.DYB	LFH	-	-	3	0	3	-	-	-	-	-	R	M	4	GLFL
			Ae	loamy sand	PL	0	10	10	-	-	-	-	-				
			Btj	sandy loam	SBK	10	35	25	-	-	-	-	-				
			C	sand	SGR	35	65	30	-	-	-	-	-				
NR18MS043	Brunisol	E.DYB	LFH	-	-	1	0	1	-	-	-	-	-	R	M	4	GLFL
			Ae	loamy sand	PL	1	1	0	-	-	-	-	-				
			Ahe	loamy sand	-	0	1	1	10YR 4/1	-	-	-	-				
			Bm	loamy sand	SBK	1	3	2	-	-	-	-	-				
			C	sand	SGR	3	25	22	-	-	-	-	-				
NR18MS044	Brunisol	E.DYB	LFH	-	-	1	0	1	-	-	-	-	-	R	M	3	GLFL
			Ae	-	-	0	8	8	-	-	-	-	-				
			Bm	loamy sand	-	8	30	22	-	-	-	-	-				
NR18MS045	Brunisol	E.DYB	LFH	-	-	1	0	1	-	-	-	-	-	W	M	4	GLFL
			Ae	loamy sand	PL	2	20	18	-	-	-	-	-				
			Ahe	loamy sand	-	0	2	2	-	-	-	-	-				
			Bm	loamy sand	SBK	20	40	20	-	-	-	-	-				
			C	loamy sand	-	40	100	60	-	-	-	-	-				

Table C-1: Terrain and Soil Characteristics Obtained at Each Inspection Site

Site	Soil Order	Subgroup[a]	Horizon	Texture	Structure[b]	Top Depth (cm)	Bottom Depth (cm)	Horizon Thickness (cm)	Color	Mottle Abundance	Mottle Dimension	Mottle Contrast	Mottle Color	Drainage[c]	Slope Position[d]	Slope Class[e]	Parent Material[f]
NR18MS046	Brunisol	E.DYB	LFH	-	-	2	0	2	-	-	-	-	-	R	M	5	GLFL
			Ae	loamy sand	-	2	10	8	-	-	-	-	-				
			Ahe	loamy sand	-	0	2	2	-	-	-	-	-				
			Bm	loamy sand	-	10	40	30	-	-	-	-	-				
			C	loamy sand	-	40	45	5	-	-	-	-	-				
NR18MS047	Brunisol	E.DYB	LFH	-	-	3	0	3	-	-	-	-	-	W	M	5	GLFL
			Ae	loamy sand	PL	0	19	19	-	-	-	-	-				
			Bm	loamy sand	SBK	19	45	26	-	-	-	-	-				
			BC	loamy sand	SBK	45	60	15	-	-	-	-	-				
			C	sand	SGR	60	75	15	-	-	-	-	-				
NR18MS048	Brunisol	E.DYB	LFH	-	-	1	0	1	-	-	-	-	-	W	M	6	GLFL
			Ae	loamy sand	-	0	20	20	-	-	-	-	-				
			Bm	loamy sand	-	20	35	15	-	-	-	-	-				
			C	loamy sand	-	35	50	15	-	-	-	-	-				
NR18MS049	Brunisol	GLE.DYB	LFH	-	-	5	0	5	-	-	-	-	-	MW	L	6	GLFL
			Ae	loamy sand	PL	0	24	24	-	-	-	-	-				
			Aegj	sandy loam	PL	24	32	8	-	Few	Fine	Faint	Faint				
			Btjgj	loam	SBK	32	47	15	-	Few	Fine	Faint	Faint				
			C	loamy sand	MA	47	65	18	-	-	-	-	-				
NR18MS050	Brunisol	E.DYB	LFH	-	-	2	0	2	-	-	-	-	-	W	U	3	GLFL
			Ae	loamy sand	PL	0	24	24	-	-	-	-	-				
			Bm	loamy sand	SBK	24	42	18	-	-	-	-	-				
			C	loamy sand	-	42	70	28	-	-	-	-	-				
NR18MS051	Brunisol	E.DYB	LFH	-	-	2	0	2	-	-	-	-	-	W	U	3	GLFL
			Ae	loamy sand	PL	0	9	9	-	-	-	-	-				
			Bm	loamy sand	SBK	9	30	21	-	-	-	-	-				
			C	sand	-	30	50	20	-	-	-	-	-				
NR18MS052	Brunisol	E.DYB	LFH	-	-	2	0	2	-	-	-	-	-	W	C	3	GLFL
			Ae	loamy sand	-	0	22	22	-	-	-	-	-				
			Bm	loamy sand	-	22	35	13	-	-	-	-	-				
			C	loamy sand	-	35	40	5	-	-	-	-	-				

Table C-1: Terrain and Soil Characteristics Obtained at Each Inspection Site

Site	Soil Order	Subgroup[a]	Horizon	Texture	Structure[b]	Top Depth (cm)	Bottom Depth (cm)	Horizon Thickness (cm)	Color	Mottle Abundance	Mottle Dimension	Mottle Contrast	Mottle Color	Drainage[c]	Slope Position[d]	Slope Class[e]	Parent Material[f]
NR18MS053	Brunisol	E.DYB	LFH	-	-	2	0	2	-	-	-	-	-	W	M	3	GLFL
			Ae	loamy sand	-	0	20	20	-	-	-	-	-				
			Bm	loamy sand	-	20	45	25	-	-	-	-	-				
			BC	loamy sand	-	45	55	10	-	-	-	-	-				
			C	loamy sand	-	55	60	5	-	-	-	-	-				
NR18MS054	Brunisol	E.DYB	LFH	-	-	2	0	2	-	-	-	-	-	W	M	4	GLFL
			Ae	loamy sand	PL	0	17	17	7.5YR 6/2	-	-	-	-				
			Bm	loamy sand	SBK	17	40	23	7.5YR 5/8	-	-	-	-				
NR18MS055	Gleysol	O.G	LFH	-	-	5	0	5	-	-	-	-	-	P	L	4	GLFL
			Aegj	loamy sand	PL	0	14	14	-	Few	Medium	Faint	Faint				
			Bg	loamy sand	SBK	14	50	36	-	Many	Medium	Prominent	Prominent				
			Cg	loamy sand	-	50	65	15	-	-	-	-	-				
NR18MS056	Brunisol	E.DYB	LFH	-	-	4	0	4	-	-	-	-	-	W	M	7	GLFL
			Ae	loamy sand	PL	0	16	16	-	-	-	-	-				
			Bm	loamy sand	SBK	16	45	29	-	-	-	-	-				
			C	loamy sand	MA	45	70	25	-	-	-	-	-				
NR18MS057	Brunisol	E.DYB	LFH	-	-	3	0	3	-	-	-	-	-	W	M	4	GLFL
			Ae	loamy sand	SBK	0	15	15	-	-	-	-	-				
			Bm	loamy sand	SBK	15	35	20	-	-	-	-	-				
			C	sand	SGR	35	60	25	-	-	-	-	-				
NR18MS058	Brunisol	E.DYB	LFH	-	-	2	0	2	-	-	-	-	-	W	U	3	GLFL
			Ae	loamy sand	PL	0	13	13	7.5 7/1	-	-	-	-				
			Bm	loamy sand	SBK	13	34	21	7.5YR 5/6	-	-	-	-				
			C	sand	SGR	34	100	66	10YR 7/3	-	-	-	-				
NR18MS059	Brunisol	E.DYB	LFH	-	-	2	0	2	-	-	-	-	-	W	M	3	GLFL
			Ae	sand	-	0	20	20	-	-	-	-	-				
			Bm	loamy sand	-	20	40	20	-	-	-	-	-				
			C	sand	-	40	100	60	-	-	-	-	-				
NR18MS060	Brunisol	E.DYB	LFH	-	-	2	0	2	-	-	-	-	-	W	M	4	GLFL
			Ae	loamy sand	SGR	0	14	14	-	-	-	-	-				
			Bm	loamy sand	SBK	14	34	20	-	-	-	-	-				
			C	sand	SGR	34	55	21	-	-	-	-	-				

Table C-1: Terrain and Soil Characteristics Obtained at Each Inspection Site

Site	Soil Order	Subgroup[a]	Horizon	Texture	Structure[b]	Top Depth (cm)	Bottom Depth (cm)	Horizon Thickness (cm)	Color	Mottle Abundance	Mottle Dimension	Mottle Contrast	Mottle Color	Drainage[c]	Slope Position[d]	Slope Class[e]	Parent Material[f]
NR18MS061	Brunisol	E.DYB	LFH	-	-	2	0	2	-	-	-	-	-	W	U	3	GLFL
			Ae	sand	SGR	0	14	14	-	-	-	-	-				
			Bm	loamy sand	SBK	14	40	26	-	-	-	-	-				
			BC	sand	SGR	40	55	15	-	-	-	-	-				
			C	sand	SGR	55	75	20	-	-	-	-	-				
NR18MS062	Brunisol	E.DYB	LFH	-	-	2	0	2	-	-	-	-	-	R	U	6	GLFL
			Ae	loamy sand	-	0	30	30	-	-	-	-	-				
			Bm	loamy sand	-	30	50	20	-	-	-	-	-				
			C	loamy sand	-	50	55	5	-	-	-	-	-				
NR18MS063	Brunisol	GLE.DYB	LFH	-	-	11	0	11	-	-	-	-	-	MW	M	3	GLFL
			Ae	sandy loam	PL	0	10	10	-	-	-	-	-				
			ABgj	sandy loam	PL	10	18	8	-	-	-	-	-				
			Bmgj	sandy loam	SBK	18	40	22	-	-	-	-	-				
			BCgj	sandy loam	MA	40	55	15	-	-	-	-	-				
			C	sandy loam	MA	55	75	20	-	-	-	-	-				
NR18MS064	Brunisol	E.DYB	LFH	-	-	8	0	8	-	-	-	-	-	W	M	3	GLFL
			Ae	loamy sand	PL	0	11	11	-	-	-	-	-				
			Btgj	sandy loam	SBK	11	25	14	-	-	-	-	-				
			C	loamy sand	MA	25	75	50	-	-	-	-	-				
			C	sand	SGR	75	100	25	-	-	-	-	-				
NR18MS065	Brunisol	E.DYB	LFH	-	-	1	0	1	-	-	-	-	-	W	L	3	GLFL
			Ae	sandy loam	PL	0	5	5	-	-	-	-	-				
			Bm	sandy loam	SBK	5	26	21	-	-	-	-	-				
			BCgj	sandy loam	SBK	26	40	14	-	-	-	-	-				
			Cgj	sand	MA	40	90	50	-	-	-	-	-				
NR18MS066	Brunisol	GLE.DYB	LFH	-	-	3	0	3	-	-	-	-	-	MW	V	1	GLFL
			Ae	sandy loam	-	0	22	22	-	-	-	-	-				
			Bmgj	sandy loam	-	22	35	13	-	Few	Fine	Faint	Faint				
			BCgj	loam	-	35	52	17	-	Many	Medium	Faint	Faint				
			Cgj	loamy sand	-	52	90	38	-	-	-	-	-				
NR18MS067	Brunisol	E.DYB	LFH	-	-	2	0	2	-	-	-	-	-	W	V	1	GLFL
			Ae	loamy sand	PL	0	15	15	-	-	-	-	-				
			Bm	loamy sand	SBK	15	29	14	-	-	-	-	-				
			C	sand	-	29	65	36	-	-	-	-	-				

Table C-1: Terrain and Soil Characteristics Obtained at Each Inspection Site

Site	Soil Order	Subgroup[a]	Horizon	Texture	Structure[b]	Top Depth (cm)	Bottom Depth (cm)	Horizon Thickness (cm)	Color	Mottle Abundance	Mottle Dimension	Mottle Contrast	Mottle Color	Drainage[c]	Slope Position[d]	Slope Class[e]	Parent Material[f]
NR18MS068	Brunisol	E.DYB	LFH	-	-	5	0	5	-	-	-	-	-	W	M	4	GLFL
			Ahb	silt loam	GR	18	21	3	-	-	-	-	-				
			Ae	sandy loam	PL	0	5	5	-	-	-	-	-				
			Aeb	sandy loam	PL	21	34	13	-	-	-	-	-				
			Bm	sandy loam	SBK	5	18	13	-	-	-	-	-				
			BC	sandy loam	MA	34	36	2	-	-	-	-	-				
			C	sand	SGR	56	70	14	-	-	-	-	-				
			C	sandy loam	MA	36	56	20	-	-	-	-	-				
NR18MS069	Brunisol	E.DYB	LFH	-	-	5	0	5	-	-	-	-	-	W	L	3	GLFL
			Ae	loamy sand	SBK	0	20	20	-	-	-	-	-				
			Bm	loamy sand	SBK	20	35	15	-	-	-	-	-				
			C	sand	SGR	35	60	25	-	-	-	-	-				
NR18MS070	Brunisol	E.DYB	LFH	-	-	2	0	2	-	-	-	-	-	W	M	6	GLFL
			Ae	loamy sand	PL	0	22	22	-	-	-	-	-				
			Bm	loamy sand	SBK	22	42	20	-	-	-	-	-				
			C	sand	SGR	42	95	53	-	-	-	-	-				
NR18MS071	Brunisol	E.DYB	LFH	-	-	2	0	2	-	-	-	-	-	W	M	6	GLFL
			Ae	loamy sand	PL	0	30	30	-	-	-	-	-				
			Bm	loamy sand	SBK	30	40	10	-	-	-	-	-				
NR18MS072	Brunisol	E.DYB	LFH	-	-	3	0	3	-	-	-	-	-	W	U	5	GLFL
			Ae	loamy sand	-	0	16	16	-	-	-	-	-				
			Bm	loamy sand	SBK	16	35	19	-	-	-	-	-				
			C	loamy sand	-	35	65	30	-	-	-	-	-				
NR18MS073	Brunisol	E.DYB	LFH	-	-	4	0	4	-	-	-	-	-	W	L	3	GLFL
			Ae	loamy sand	PL	0	17	17	-	-	-	-	-				
			Bm	sandy loam	SBK	17	40	23	-	-	-	-	-				
			C	sand	SGR	40	100	60	-	-	-	-	-				
NR18MS074	Brunisol	E.DYB	LFH	-	-	1	0	1	-	-	-	-	-	W	U	3	GLFL
			Ae	loamy sand	-	0	10	10	-	-	-	-	-				
			Bm	sandy loam	-	10	35	25	-	-	-	-	-				
			C	loamy sand	-	35	70	35	-	-	-	-	-				

Table C-1: Terrain and Soil Characteristics Obtained at Each Inspection Site

Site	Soil Order	Subgroup[a]	Horizon	Texture	Structure[b]	Top Depth (cm)	Bottom Depth (cm)	Horizon Thickness (cm)	Color	Mottle Abundance	Mottle Dimension	Mottle Contrast	Mottle Color	Drainage[c]	Slope Position[d]	Slope Class[e]	Parent Material[f]
NR18MS075	Brunisol	E.DYB	LFH	-	-	2	0	2	-	-	-	-	-	W	M	6	GLFL
			Ae	loamy sand	PL	0	19	19	7.5YR 6/2	-	-	-	-				
			Bm	loamy sand	SBK	19	40	21	10YR 4/6	-	-	-	-				
			C	sand	SGR	65	85	20	10YR 6/4	-	-	-	-				
			C	sand	SGR	40	65	25	10YR 6/4	-	-	-	-				
NR18MS076	Brunisol	E.DYB	LFH	-	-	2	0	2	-	-	-	-	-	W	M	6	GLFL
			Ae	sand	PL	0	15	15	-	-	-	-	-				
			Bm	sandy loam	SBK	15	38	23	-	-	-	-	-				
			C	sand	SGR	38	60	22	-	-	-	-	-				
NR18MS077	Organic	T.M	Of	-	-	0	40	40	-	-	-	-	-	VP	D	1	FNPT/GLFL
			Om	sand	-	40	95	55	-	-	-	-	-				
			Cg	loamy sand	-	95	110	15	-	-	-	-	-				
NR18MS078	Brunisol	E.DYB	LFH	-	-	8	0	8	-	-	-	-	-	W	U	7	GLFL
			Ae	loamy sand	PL	0	12	12	-	-	-	-	-				
			Btj	sandy loam	SBK	12	30	18	-	-	-	-	-				
			BC	loamy sand	-	30	45	15	-	-	-	-	-				
NR18MS079	Brunisol	E.DYB	LFH	-	-	3	0	3	-	-	-	-	-	W	U	4	GLFL
			Ae	loamy sand	PL	0	8	8	-	-	-	-	-				
			Bm	loamy sand	SBK	8	40	32	-	-	-	-	-				
			C	sand	SGR	40	90	50	-	-	-	-	-				
NR18MS080	Brunisol	E.DYB	LFH	-	-	3	0	3	-	-	-	-	-	W	M	3	GLFL
			Ae	loamy sand	-	0	12	12	-	-	-	-	-				
			Btj	sandy loam	-	12	25	13	-	-	-	-	-				
NR18MS081	Brunisol	E.DYB	LFH	-	-	2	0	2	-	-	-	-	-	R	M	4	GLFL
			Ae	sand	SGR	0	10	10	-	-	-	-	-				
			Bm	loamy sand	SBK	10	35	25	-	-	-	-	-				
			BC	loamy sand	SGR	35	40	5	-	-	-	-	-				
			C	-	-	40	-	-	-	-	-	-	-				
NR18MS082	Brunisol	E.DYB	LFH	-	-	2	0	2	-	-	-	-	-	R	U	3	GLFL
			Ae	loamy sand	PL	0	7	7	10YR 6/1	-	-	-	-				
			Btj	sandy loam	SBK	7	35	28	10YR 5/6	-	-	-	-				
			BC	loamy sand	MA	35	45	10	-	-	-	-	-				

Table C-1: Terrain and Soil Characteristics Obtained at Each Inspection Site

Site	Soil Order	Subgroup[(a)]	Horizon	Texture	Structure[(b)]	Top Depth (cm)	Bottom Depth (cm)	Horizon Thickness (cm)	Color	Mottle Abundance	Mottle Dimension	Mottle Contrast	Mottle Color	Drainage[(c)]	Slope Position[(d)]	Slope Class[(e)]	Parent Material[(f)]
NR18MS083	Brunisol	E.DYB	LFH	-	-	1	0	1	-	-	-	-	-	R	M	4	GLFL
			Ae	loamy sand	PL	0	8	8	-	-	-	-	-				
			Bm	loamy sand	SBK	8	30	22	-	-	-	-	-				
			C	loamy sand	SGR	30	55	25	-	-	-	-	-				
NR18MS084	Brunisol	E.DYB	LFH	-	-	1	0	1	-	-	-	-	-	R	M	3	GLFL
			Ae	loamy sand	-	0	10	10	-	-	-	-	-				
			Bm	loamy sand	-	10	35	25	-	-	-	-	-				
			C	loamy sand	-	35	100	65	-	-	-	-	-				
NR18MS085	Brunisol	E.DYB	LFH	-	-	2	0	2	-	-	-	-	-	R	M	2	GLFL
			Ae	loamy sand	PL	3	33	30	7.5YR 7/2	-	-	-	-				
			Ahe	loamy sand	PL	0	3	3	10YR 4/1	-	-	-	-				
			Bm	loamy sand	SBK	33	58	25	10YR 5/8	-	-	-	-				
			C	loamy sand	SGR	58	90	32	-	-	-	-	-				
NR18MS086	Brunisol	E.DYB	LFH	-	-	1	0	1	-	-	-	-	-	W	V	1	GLFL
			Ae	loamy sand	PL	0	9	9	-	-	-	-	-				
			Bm	loamy sand	SBK	9	34	25	-	-	-	-	-				
			C	loamy sand	MA	34	75	41	-	-	-	-	-				
NR18MS087	Brunisol	E.DYB	LFH	-	-	2	0	2	-	-	-	-	-	W	U	4	GLFL
			Ae	loamy sand	-	0	15	15	-	-	-	-	-				
			Bm	loamy sand	-	15	32	17	-	-	-	-	-				
			C	loamy sand	-	32	65	33	-	-	-	-	-				
NR18MS088	Brunisol	E.DYB	LFH	-	-	1	0	1	-	-	-	-	-	W	U	2	GLFL
			Ae	loamy sand	PL	0	5	5	-	-	-	-	-				
			AB	loamy sand	PL	5	10	5	-	-	-	-	-				
			Bm	loamy sand	SBK	10	30	20	-	-	-	-	-				
			C	loamy sand	SGR	30	100	70	-	-	-	-	-				
NR18MS089	Organic	FI.M	Of	-	-	0	80	80	-	-	-	-	-	VP	V	1	SPPT
			Om	-	-	80	220	140	-	-	-	-	-				
NR18MS090	Organic	ME.F	Of	-	-	0	125	125	-	-	-	-	-	VP	V	1	SPPT
			Om	-	-	125	220	95	-	-	-	-	-				
NR18MS091	Organic	FI.M	Of	-	-	0	85	85	-	-	-	-	-	VP	V	1	SPPT
			Om	-	-	85	220	135	-	-	-	-	-				

Table C-1: Terrain and Soil Characteristics Obtained at Each Inspection Site

Site	Soil Order	Subgroup[a]	Horizon	Texture	Structure[b]	Top Depth (cm)	Bottom Depth (cm)	Horizon Thickness (cm)	Color	Mottle Abundance	Mottle Dimension	Mottle Contrast	Mottle Color	Drainage[c]	Slope Position[d]	Slope Class[e]	Parent Material[f]
NR18MS092	Brunisol	GLE.DYB	LFH	-	-	1	0	1	-	-	-	-	-	MW	M	4	GLFL
			Ahe	loamy sand	-	0	3	3	-	-	-	-	-				
			Ae	sand	SGR	3	13	10	-	-	-	-	-				
			Bmgj	sand	SGR	13	37	24	-	-	-	-	-				
			Cgj	sand	SGR	37	65	28	-	-	-	-	-				
NR18MS093	Organic	T.M	Of	-	-	0	40	40	-	-	-	-	-	VP	V	1	SPPT
			Om	-	-	40	145	105	-	-	-	-	-				
			Cg	loamy sand	-	145	155	10	-	-	-	-	-				
NR18MS094	Brunisol	E.DYB	LFH	-	-	2	0	2	-	-	-	-	-	W	M	6	GLFL
			Ae	loamy sand	PL	0	12	12	-	-	-	-	-				
			Btj	sandy loam	SBK	12	40	28	-	-	-	-	-				
			C	loamy sand	MA	40	50	10	-	-	-	-	-				
NR18MS095	Brunisol	E.DYB	LFH	-	-	2	0	2	-	-	-	-	-	W	U	6	GLFL
			Ae	loamy sand	PL	0	10	10	-	-	-	-	-				
			Bm	loamy sand	SBK	10	33	23	-	-	-	-	-				
			C	loamy sand	MA	33	70	37	-	-	-	-	-				
NR18MS096	Brunisol	GLE.DYB	LFH	-	-	9	0	9	-	-	-	-	-	I	L	3	GLFL
			Ahe	silt loam	PL	0	5	5	10YR 5/1	Few	Fine	Faint	Faint				
			Bmgj	silt loam	SBK	5	24	19	10YR 6/6	Many	Medium	Distinct	Distinct				
			BCgj	sandy loam	SBK	24	55	31	10YR 6/4	Many	Fine	Faint	Faint				
			C	loamy sand	MA	55	100	45	10YR 7/4	Many	Fine	Faint	Faint				
NR18MS097	Brunisol	E.DYB	LFH	-	-	9	0	9	-	-	-	-	-	W	M	4	GLFL
			Ae	sandy loam	PL	0	14	14	-	-	-	-	-				
			Bm	sandy loam	-	14	19	5	-	-	-	-	-				
NR18MS098	Brunisol	E.DYB	LFH	-	-	3	0	3	-	-	-	-	-	W	L	4	GLFL
			Ae	loamy sand	PL	0	16	16	-	-	-	-	-				
			Bm	sandy loam	SBK	16	37	21	-	-	-	-	-				
			C	sand	SGR	37	65	28	-	-	-	-	-				
NR18MS099	Brunisol	E.DYB	LFH	-	-	3	0	3	-	-	-	-	-	W	M	4	GLFL
			Ae	loamy sand	PL	0	15	15	-	-	-	-	-				
			Bm	loamy sand	SBK	15	40	25	-	-	-	-	-				
			C	sand	SGR	40	70	30	-	-	-	-	-				
NR18MS100	Brunisol	E.DYB	LFH	-	-	3	0	3	-	-	-	-	-	W	M	4	GLFL
			Ae	loamy sand	-	0	17	17	-	-	-	-	-				
			Bm	loamy sand	-	17	35	18	-	-	-	-	-				
			BC	loamy sand	-	35	45	10	-	-	-	-	-				
			C	loamy sand	-	45	-	-	-	-	-	-	-				

Table C-1: Terrain and Soil Characteristics Obtained at Each Inspection Site

Site	Soil Order	Subgroup[a]	Horizon	Texture	Structure[b]	Top Depth (cm)	Bottom Depth (cm)	Horizon Thickness (cm)	Color	Mottle Abundance	Mottle Dimension	Mottle Contrast	Mottle Color	Drainage[c]	Slope Position[d]	Slope Class[e]	Parent Material[f]
NR18MS101	Brunisol	E.DYB	LFH	-	-	2	0	2	-	-	-	-	-	W	M	5	GLFL
			Ae	loamy sand	PL	0	10	10	-	-	-	-	-				
			Bm	loamy sand	SBK	10	35	25	-	-	-	-	-				
			C	loamy sand	MA	35	100	65	-	-	-	-	-				
NR18MS102	Brunisol	E.DYB	LFH	-	-	2	0	2	-	-	-	-	-	W	M	4	GLFL
			Ae	loamy sand	-	0	14	14	-	-	-	-	-				
			Bm	loamy sand	-	14	34	20	-	-	-	-	-				
			BC	loamy sand	-	34	45	11	-	-	-	-	-				
			C	sand	SGR	45	100	55	-	-	-	-	-				
NR18MS103	Brunisol	E.DYB	LFH	-	-	2	0	2	-	-	-	-	-	W	M	4	GLFL
			Ae	loamy sand	PL	0	7	7	7.5YR 6/1	-	-	-	-				
			Btj	sandy loam	SBK	7	32	25	10YR 5/8	-	-	-	-				
			C	loamy sand	MA	32	100	68	10YR 6/6	-	-	-	-				
NR18MS104	Brunisol	E.DYB	LFH	-	-	2	0	2	- --	-	-	-	-	W	L	5	GLFL
			Ae	loamy sand	PL	0	19	19	7.5YR 7/2	-	-	-	-				
			Bm	loamy sand	SBK	19	40	21	7.5YR 5/6	-	-	-	-				
			BC	loamy sand	-	40	65	25	10YR 6/6	-	-	-	-				
			C	sand	-	65	100	35	10YR 7/4	-	-	-	-				
NR18MS105	Brunisol	E.DYB	LFH	-	-	2	0	2	-	-	-	-	-	W	U	5	GLFL
			Ahe	loamy sand	PL	0	3	3	-	-	-	-	-				
			Ae	loamy sand	PL	3	12	9	-	-	-	-	-				
			Btg	loamy sand	SBK	12	30	18	-	-	-	-	-				
			C	loamy sand	-	30	60	30	-	-	-	-	-				
NR18MS106	Brunisol	GLE.DYB	LFH	-	-	2	0	2	-	-	-	-	-	MW	T	4	GLFL
			Ae	sandy loam	-	0	5	5	-	-	-	-	-				
			Bmgj	sandy loam	-	5	40	35	-	Common	Medium	Faint	Faint				
			BCgj	sandy loam	-	40	75	35	-	Many	Medium	Distinct	Distinct				
NR18MS107	Organic	T.H	Of	-	-	0	20	20	-	-	-	-	-	VP	M	3	FNPT/GLFL
			Om	-	-	20	30	10	-	-	-	-	-				
			Oh	-	-	30	60	30	-	-	-	-	-				
			Cg	loamy sand	-	60	75	15	-	-	-	-	-				
NR18MS008	Brunisol	E.DYB	LFH			5	0	5	-								
			Aegj	sand		0	32	32	-								
			Bg	sand		32	45	13	-					R	U	4	GLFL

Table C-1: Terrain and Soil Characteristics Obtained at Each Inspection Site

Site	Soil Order	Subgroup[a]	Horizon	Texture	Structure[b]	Top Depth (cm)	Bottom Depth (cm)	Horizon Thickness (cm)	Color	Mottle Abundance	Mottle Dimension	Mottle Contrast	Mottle Color	Drainage[c]	Slope Position[d]	Slope Class[e]	Parent Material[f]
NR18MS109	Brunisol	E.DYB	LFH	-	-	2	0	2	-	-	-	-	-	W	U	3	GLFL
			Ae	loamy sand	PL	0	5	5	-	-	-	-	-				
			Bm	loamy sand	SBK	5	30	25	-	-	-	-	-				
			C	loamy sand	MA	30	60	30	-	-	-	-	-				
NR18MS110	Brunisol	E.DYB	LFH	-	-	1	0	1	-	-	-	-	-	W	V	2	GLFL
			Ahe	loamy sand	PL	3	9	6	10YR 5/1	-	-	-	-				
			Ah	loamy sand	PL	0	3	3	10YR 3/1	-	-	-	-				
			Bm	loamy sand	PL	9	50	41	10YR 6/8	-	-	-	-				
			C	sand	SGR	50	65	15	-	-	-	-	-				
NR18MS111	Brunisol	GLE.DYB	LFH	-	-	3	0	3	-	-	-	-	-	MW	L	3	GLFL
			Ae	loamy sand	PL	0	6	6	7.5YR 6/2	-	-	-	-				
			Btjgj	sandy loam	SBK	6	30	24	10YR 6/6	Many	Medium	Distinct	Distinct				
			BCgj	sandy clay loam	MA	30	50	20	2.5Y 5/2	Few	Fine	Faint	Faint				
			C	sand	SGR	50	65	15	10YR 7/6	-	-	-	-				
NR18MS112	Brunisol	GLE.DYB	LFH	-	-	10	0	10	-	-	-	-	-	MW	M	3	GLFL
			Ae	sandy loam	PL	0	10	10	-	-	-	-	-				
			Bmgj	sandy loam	SBK	10	40	30	-	Many	Medium	Distinct	Distinct				
			Cgj	sandy loam	MA	60	80	20	-	-	-	-	-				
			Cgj	sandy loam	MA	40	60	20	-	-	-	-	-				
19-EXP01-A-SO1	Brunisol	E.DYB	LFH	-	-	1	0	1	-	-	-	-	-	-	-	-	GLFL
			Ahe	loamy sand	SGR	0	3	3	7.5YR 5/1	-	-	-	-				
			Ae	loamy sand	SGR	3	17	14	10YR 7/1	-	-	-	-				
			Bm	loamy sand	SBK	17	34	17	10YR 6/6	-	-	-	-				
			C	sand	MA	34			10YR 7/2	-	-	-	-				
19-EXP01-A-SO2	Brunisol	E.DYB	LFH	-	-	1	0	1	-	-	-	-	-	-	-	-	GLFL
			Ahe	loamy sand	SGR	0	1	1	7.5YR 5/1	-	-	-	-				
			Ae	loamy sand	SGR	1	22	21	10YR 7/1	-	-	-	-				
			Bm	loamy sand	SBK	22	36	14	10YR 6/6	-	-	-	-				
			C	loamy sand	MA	36			10YR 7/2	-	-	-	-				
19-EXP01-A-SO3	Brunisol	E.DYB	LFH	-	-	1	0	1	-	-	-	-	-	-	-	-	GLFL
			Ahe	loamy sand	SGR	0	4	4	7.5YR 5/1	-	-	-	-				
			Ae	loamy sand	SGR	4	18	14	10YR 7/1	-	-	-	-				
			Bm	loamy sand	SBK	18	45	27	7.5YR 5/8	-	-	-	-				
			C	loamy sand	MA	45			10YR 7/2	-	-	-	-				
19-EXP01-B-SO1	Brunisol	E.DYB	LFH	-	-	1	0	1	-	-	-	-	-	-	-	-	GLFL
			Ahe	loamy sand	SGR	0	4	4	7.5YR 4/1	-	-	-	-				
			Ae	loamy sand	SGR	4	27	23	7.5YR 7/2	-	-	-	-				
			Bm	loamy sand	SBK	27	40	13	10YR 5/8	-	-	-	-				
			C	loamy sand	MA	40			10YR 8/3	-	-	-	-				
19-EXP01-B-SO2	Brunisol	E.DYB	LFH	-	-	1	0	1	-	-	-	-	-	-	-	-	GLFL
			Ahe	loamy sand	SGR	0	3	3	7.5YR 5/2	-	-	-	-				
			Ae	loamy sand	SGR	3	13	10	7.5YR 6/2	-	-	-	-				
			Bm	loamy sand	SBK	13	20	7	7.5YR 5/8	-	-	-	-				
			C	loamy sand	MA	20			10YR 6/4	-	-	-	-				
19-EXP01-B-SO3	Brunisol	E.DYB	LFH	-	-	1	0	1	-	-	-	-	-	-	-	-	GLFL
			Ae	loamy sand	SGR	0	17	17	10YR 7/3	-	-	-	-				
			Bm	loamy sand	SBK	17	32	15	7.5YR 5/8	-	-	-	-				
			C	loamy sand	MA	32			10YR 5/6	-	-	-	-				
19-EXP01-C-SO1	Brunisol	E.DYB	LFH	-	-	1	0	1	-	-	-	-	-	-	-	-	GLFL
			Ahe	loamy sand	SGR	0	2	2	7.5YR 5/2	-	-	-	-				
			Ae	loamy sand	SGR	2	14	12	10YR 7/2	-	-	-	-				
			Bm	loamy sand	SBK	14	39	25	10YR 5/8	-	-	-	-				
			C	sand	MA	39			10YR 7/2	-	-	-	-				
			LFH	-	-	1	0	1	-	-	-	-	-				
			Ahe	loamy sand	SGR	0	4	4	7.5YR 4/1	-	-	-	-				

Table C-1: Terrain and Soil Characteristics Obtained at Each Inspection Site

Site	Soil Order	Subgroup[a]	Horizon	Texture	Structure[b]	Top Depth (cm)	Bottom Depth (cm)	Horizon Thickness (cm)	Color	Mottle Abundance	Mottle Dimension	Mottle Contrast	Mottle Color	Drainage[c]	Slope Position[d]	Slope Class[e]	Parent Material[f]
19-EXP01-C-SO2	Brunisol	E.DYB	Ae	loamy sand	SGR	4	13	9	7.5YR 7/2	-	-	-	-	-	-	-	GLFL
			Bm	loamy sand	SBK	13	36	23	7.5YR 5/8	-	-	-	-				
			C	loamy sand	MA	36			10YR 8/3	-	-	-	-				
19-EXP01-C-SO3	Brunisol	E.DYB	LFH	-	-	1	0	1	-	-	-	-	-	-	-	-	GLFL
			Ahe	loamy sand	SGR	0	3	3	7.5YR 5/2	-	-	-	-				
			Ae	loamy sand	SGR	3	24	21	7.5YR 7/2	-	-	-	-				
			Bm	loamy sand	SBK	24	40	16	7.5YR 5/8	-	-	-	-				
			C	sand	MA	40			7.5YR 8/3	-	-	-	-				
19-EXP02-A-SO1	Regosol	O.R	LFH	-	-	8	0	8	-	-	-	-	-	-	-	-	GLFL
			Ae	loamy sand	SGR	0	17	17	10YR 5/4	-	-	-	-				
			C	loamy sand	MA	17			10YR 6/6	-	-	-	-				
19-EXP02-A-SO2	Brunisol	E.DYB	LFH	-	-	7	0	7	-	-	-	-	-	-	-	-	GLFL
			Ae	loamy sand	SGR	0	15	15	7.5YR 7/2	-	-	-	-				
			Bm	loamy sand	SGR	15	32	17	10YR 6/8	-	-	-	-				
			C	loamy sand	MA	32			10YR 6/3	-	-	-	-				
19-EXP02-A-SO3	Regosol	O.R	LFH	-	-	7	0	7	-	-	-	-	-	-	-	-	GLFL
			Ae	loamy sand	SGR	0	8	8	7.5YR 5/2	-	-	-	-				
			C	-	MA	8			7.5YR 6/2	-	-	-	-				
19-EXP02-B-SO1	Brunisol	E.DYB	LFH	-	-	7	0	7	-	-	-	-	-	-	-	-	GLFL
			Ahe	loamy sand	SGR	0	9	9	10YR 3/2	-	-	-	-				
			Ae	loamy sand	SGR	9	33	24	7.5YR 7/2	-	-	-	-				
			Bm	loamy sand	SGR	33	49	16	10YR 7/8	-	-	-	-				
			C	loamy sand	MA	49			10YR 8/4	-	-	-	-				
19-EXP02-B-SO2	Regosol	O.R	LFH	-	-	5	0	5	-	-	-	-	-	-	-	-	GLFL
			Ae	loamy sand	SGR	0	37	37	10YR 8/1	-	-	-	-				
			C	loamy sand	MA	37			10YR 5/6	-	-	-	-				
19-EXP02-B-SO3	Brunisol	E.DYB	LFH	-	-	9	0	9	-	-	-	-	-	-	-	-	GLFL
			Ahe	loamy sand	SGR	0	1	1	5YR 5/2	-	-	-	-				
			Ae	loamy sand	SGR	1	18	17	7.5YR 7/1	-	-	-	-				
			Bm	loamy sand	SGR	18	34	16	7.5YR 5/6	-	-	-	-				
			C	loamy sand	MA	34			10YR 7/1	-	-	-	-				
19-EXP02-C-SO1	Brunisol	E.DYB	LFH	-	-	7	0	7	-	-	-	-	-	-	-	-	GLFL
			Ae	loamy sand	SGR	0	23	23	7.5YR 5/3	-	-	-	-				
			Bm	loamy sand	SBK	23	38	15	7.5YR 4/4	-	-	-	-				
			C	loamy sand	MA	38			10YR 4/3	-	-	-	-				
19-EXP02-C-SO2	Brunisol	E.DYB	LFH	-	-	6	0	6	-	-	-	-	-	-	-	-	GLFL
			Ae	loamy sand	SGR	0	14		7.5YR 6/2	-	-	-	-				
			Bm	loamy sand	SBK	14	39	25	7.5YR 4/4	-	-	-	-				
			C	loamy sand	MA	39			10YR 4/4	-	-	-	-				
19-EXPO3-A-SO1	Brunisol	E.DYB	LFH	-	-	1	0	1	-	-	-	-	-	-	-	-	GLFL
			Ahe	loamy sand	SGR	0	1	1	5YR 5/1	-	-	-	-				
			Ae	loamy sand	SGR	1	28	27	5YR 8/1	-	-	-	-				
			Bm	loamy sand	SBK	28	36	8	10YR 6/8	-	-	-	-				
			C	loamy sand	MA	36			10YR 7/4	-	-	-	-				
19-EXPO3-B-SO1	Brunisol	E.DYB	LFH	-	-	3	0	3	-	-	-	-	-	-	-	-	GLFL
			Ahe	loamy sand	SGR	0	6	6	7.5YR 3/1	-	-	-	-				
			Ae	loamy sand	SGR	6	25	19	5YR 7/2	-	-	-	-				
			Bm	loamy sand	SBK	25	40	15	10YR 6/8	-	-	-	-				
			C	loamy sand	MA	40			10YR 7/3	-	-	-	-				
19-EXPO3-C-SO3	Brunisol	E.DYB	LFH	-	-	1	0	1	-	-	-	-	-	-	-	-	GLFL
			Ahe	loamy sand	SGR	0	1	1	10YR 5/1	-	-	-	-				
			Ae	loamy sand	SGR	1	22	21	7.5YR 7/3	-	-	-	-				
			Bm	loamy sand	SBK	22	33	11	10YR 5/6	-	-	-	-				
			C	loamy sand	MA	33			10YR 6/4	-	-	-	-				
			LFH	-	-	1	0	1	-	-	-	-	-				

Table C-1: Terrain and Soil Characteristics Obtained at Each Inspection Site

Site	Soil Order	Subgroup[a]	Horizon	Texture	Structure[b]	Top Depth (cm)	Bottom Depth (cm)	Horizon Thickness (cm)	Color	Mottle Abundance	Mottle Dimension	Mottle Contrast	Mottle Color	Drainage[c]	Slope Position[d]	Slope Class[e]	Parent Material[f]
19-REF04-A-SO1	Brunisol	E.DYB	Ahe	loamy sand	SGR	0	2	2	10YR 4/1	-	-	-	-	-	-	-	GLFL
			Ae	loamy sand	SGR	2	12	10	10YR 7/2	-	-	-	-				
			Bm	loamy sand	SBK	12	42	30	10YR 5/6	-	-	-	-				
			C	loamy sand	MA	42			10YR 8/4	-	-	-	-				
19-REF04-B-SO1	Brunisol	E.DYB	LFH	-	-	1	0	1	-	-	-	-	-	-	-	-	GLFL
			Ae	sand	SGR	0	12	12	10YR 7/2	-	-	-	-				
			Bm	loamy sand	SGR	12	21	9	10YR 5/8	-	-	-	-				
			C	sand	MA	21			5Y 7/2	-	-	-	-				
19-REF04-C-SO1	Brunisol	E.DYB	LFH	-	-	1	0	1	-	-	-	-	-	-	-	-	GLFL
			Ae	sand	SGR	0	5	5	5YR 7/2	-	-	-	-				
			Bm	sand	SGR	5	22	17	10YR 8/6	-	-	-	-				
			C	sand	MA	22			5Y 8/4	-	-	-	-				
19-REF05-A-SO1	Brunisol	E.DYB	LFH	-	-	1	0	1	-	-	-	-	-	-	-	-	GLFL
			Ahe	loamy sand	SGR	0	4	4	10YR 4/1	-	-	-	-				
			Ae	loamy sand	SGR	4	9	5	10YR 7/1	-	-	-	-				
			Bm	loamy sand	SBK	9	32	23	7.5YR 5/8	-	-	-	-				
			C	loamy sand	MA	32			10YR 6/6	-	-	-	-				
19-REF05-B-SO1	Brunisol	E.DYB	LFH	-	-		0		-	-	-	-	-	-	-	-	GLFL
			Ae	sandy loam	SGR	0	5	5	7.5YR 6/2	-	-	-	-				
			Bm	sandy loam	SBK	5	18	13	7.5YR 4/4	-	-	-	-				
			C	loamy sand	MA	18			10YR 5/6	-	-	-	-				
19-REF05-C-SO1	Brunisol	E.DYB	LFH	-	-	3	0	3	-	-	-	-	-	-	-	-	GLFL
			Ahe	loamy sand	SGR	0	3	3	7.5YR 4/1	-	-	-	-				
			Ae	loamy sand	SGR	3	10	7	7.5YR 7/2	-	-	-	-				
			Bm	sandy loam	SBK	10	40	30	10YR 5/8	-	-	-	-				
			C	loamy sand	MA	40			10YR 5/6	-	-	-	-				
19-REF06-A-SO1	Brunisol	E.DYB	LFH	-	-	3	0	3	-	-	-	-	-	-	-	-	GLFL
			Ahe	sand	SGR	0	1	1	10YR 3/2	-	-	-	-				
			Ae	sand	SGR	1	23	22	5Y 7/3	-	-	-	-				
			Bm	sand	SBK	23	30	7	7.5YR 5/8	-	-	-	-				
			C	sand	MA	30			10YR 8/4	-	-	-	-				
19-REF06-B-SO1	Brunisol	E.DYB	LFH	-	-	3	0	3	-	-	-	-	-	-	-	-	GLFL
			Ahe	sand	SGR	0	4	4	10YR 4/1	-	-	-	-				
			Ae	sand	SGR	4	59	55	5Y 7/2	-	-	-	-				
			Bm	sand	SGR	59	66	7	7.5YR 5/8	-	-	-	-				
			C	sand	MA	66			10YR 6/6	-	-	-	-				
19-REF06-C-SO1	Brunisol	E.DYB	LFH	-	-	1	0	1	-	-	-	-	-	-	-	-	GLFL
			Ae	sand	SGR	0	10	10	7.5YR 7/2	-	-	-	-				
			Bm	loamy sand	SGR	10	34	24	10YR 5/8	-	-	-	-				
			C	loamy sand	MA	34			10YR 7/4	-	-	-	-				

a) Soil subgroups: E.DYB = Eluviated Dystric Brunisol; FI.M = Fibric Mesisol; GLE.DYB = Gleyed Eluviated Dystric Brunisol; ME.F = Mesic Fibrisol; O.G = Orthic Gleysol; O.R = Orthic Regosol; T.H = Terric Humisol; T.M = Terric Mesisol.

b) Soil structure: SGR = single grain; SBK = subangular blocky; PL = platy; MA = amorphous (massive); GR = granular.

c) Drainage: W = well; VP = very poor; R = ; MW = moderately well; I = imperfect.

d) Slope position: V = level; U = upper slope; T = toe slope; M = mid slope; L = lower slope; D = depression; C = crest.

e) Slope class: 1 = level (0 to 0.5%); 2 = nearly level (0.5 to 2.0%); 3 = very gentle (2.0 to 5.0%); 4 = gentle (5.0 to 10.0%); 5 = moderate (10 to 15%); 6 = strong (15 to 30%); 7 = very strong (30 to 45%).

f) Parent material: SPPT = sphagnum peat; GLFL = glacial fluvial; FNPT = sedge (fen) peat.

APPENDIX D

Soil Map Characteristics

Table D-1: Soil Map Unit Characteristics

Soil Map Unit	Dominant/Co-dominant Soil Subgroup		Sub-dominant Soil Subgroup	Inclusions	Landscape	Slope Class Range	Drainage	Surface Stoniness	Comments
	>30% to <60-100%	Parent Material	>10% to <40%	<10-20%					
Mineral Soils									
Mineral-1 (M1)	Eluviated Dystric Brunisol	GLFL	-	-	Hummocky and Ridged - high relief	3 to 6 (>2% - 30%)	Rapid to Well	S4 to S5 (15% to >50%)	-
Mineral-2 (M2)	Eluviated Dystric Brunisol	GLFL	-	Gleyed Eluviated Dystric Brunisol	Undulating and Rolling	3 to 5 (>2% - 15%)	Rapid to Moderately Well	S2 to S3 (0.1% to 3%)	Gleyed Eluviated Dystric Brunisol found at low and toe
Mineral-3 (M3)	Eluviated Dystric Brunisol	GLFL	-	Gleyed Eluviated Dystric Brunisol	Hummocky and Ridged - high relief	4 to 7 (>5% - 45%)	Rapid	S4 to S5 (15% to >50%)	Gleyed Eluviated Dystric Brunisol found at low and toe; high coarse fragments in profile
Mineral-4 (M4)	Eluviated Dystric Brunisol	GLFL	Gleyed Eluviated Dystric Brunisol	Misc. Gleysols	Nearly Level to Undulating	1 to 3 (0% to 5%)	Well to Imperfect	S2 to S3 (0.1% to 3%)	-
Mineral-5 (M5)	Gleyed Eluviated Dystric Brunisol	GLFL	Eluviated Dystric Brunisol	Misc. Gleysols, Terric Mesisols	Undulating	2 to 3 (>0.5% - 5%)	Moderately Well	S2 to S3 (0.1% to 3%)	-
Mineral-6 (M6)	Orthic Gleysol	GLFL	Terric Mesisols	Gleyed Eluviated Dystric Brunisol	Level to Nearly Level	1 to 2 (0% to 2%)	Imperfect to Very Poor	S0 to S1 (<0.01% to 0.1%)	-
Mineral-7 (M7)	Eluviated Dystric Brunisol	GLFL	-	Gleyed Eluviated Dystric Brunisol	Hummocky and Ridged - low relief	2 to 4 (>0.5% to 10%)	Rapid to Well	S2 (0.1% to 3%)	Gleyed Eluviated Dystric Brunisol found at low and toe; minor amount (10-20%) of inspections showed evidence of clay
Mineral-8 (M8)	Eluviated Dystric Brunisol	GLFL	-	Gleyed Eluviated Dystric Brunisol	Hummocky and Ridged - high relief	4 to 7 (>5% - 45%)	Rapid	S4 to S5 (15% to >50%)	Gleyed Eluviated Dystric Brunisol found at low and toe; high coarse fragments in profile; moderate amount (20-40%) of
Mineral-9 (M9)	Eluviated Dystric Brunisol	GLFL	Gleyed Eluviated Dystric Brunisol	-	Undulating - low relief	2 to 4 (>0.5% to 10%)	Well to Moderately Well	S2 to S3 (0.1% to 3%)	-
Mineral-10 (M10)	Eluviated Dystric Brunisol	GLFL	-	Gleyed Eluviated Dystric Brunisol	Inclined - level	2 to 5 (>0.5% to 15%)	Rapid to Well	S3 (3% to 15%)	Gleyed Eluviated Dystric Brunisol found at low and toe; high coarse fragments in profile
Mineral-11 (M11)	Gleyed Eluviated Dystric Brunisol	GLFL	Eluviated Dystric Brunisol Misc. Gleysols	Terric Mesisol	and significant drainage channels	2 to 3 (>0.5% - 5%)	Moderately Well to Very Poor	S0 to S3 (<0.01% to 15%)	-
Mineral-12 (M12)	Eluviated Dystric Brunisol	GLFL	-	Gleyed Eluviated Dystric Brunisol, Misc. Gleysols	Undulating and Rolling	2 to 4 (>0.5% - 10%)	Rapid to Moderately Well	S1 to S2 (0.01% to 3%)	Gleyed Eluviated Dystric Brunisol found at low and toe; low coarse fragments in profile
Organic Soils									
Organic-1 (O1)	Terric Mesisol	FNPT/GLFL	-	Misc. Gleysols	Organic - level	1 (0% - 0.5%)	Very Poor	S0 (<0.01%)	-
Organic-2 (O2)	Typic Mesisol	FNPT	-	Terric Mesisol	Organic - level	1 (0% - 0.5%)	Very Poor	S0 (<0.01%)	-
Organic-3 (O3)	Typic Mesisol	FNPT	Terric Mesisol	Misc. Gleysols, Gleyed Eluviated Dystric Brunisol	Organic - level with mineral soil hummocks	1 to 3 (0% to 5%)	Imperfect to Very Poor	S0 to S2 (<0.01% to 3%)	-

GLFL = glacial-fluvial; FNPT = sedge (fen) peat; - = not applicable; % = percent.